Tier 1 Evaluation of Pollutant Sources to the Impounded Reach of Clifton 2 Mill Dam, Pacolet River, Spartanburg County, South Carolina

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U.S. Department of the Interior
Fish and Wildlife Service

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Preface

To assess the potential for sediment contamination at Clifton 2 Mill Dam in South Carolina's Pacolet River basin, the U.S. Fish and Wildlife Service assisted Spartanburg County Parks Department in a review of existing information on potential pollutant sources to sediments upstream of the dam. The work was completed by Sara Ward (Ecologist / Environmental Contaminant Specialist) and Tom Augspurger (Ecologist / Environmental Contaminant Specialist) in the U.S. Fish and Wildlife Service's Raleigh Field Office with field assistance from Thomas Rainwater (Environmental Contaminant Specialist in the U.S. Fish and Wildlife Service's Charleston Field Office). The work was funded through a transfer agreement between the U.S. Fish and Wildlife Service and Spartanburg County Parks.

This final version was prepared to address comments received on an August 2012 peer review draft. We appreciate the review and feedback from Thomas Rainwater, Lynnette Batt (American Rivers), and Cindy Carter (SC Department of Health and Environmental Control).

Questions related to this report can be directed to the U.S. Fish and Wildlife Service at the following address:

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Cover photo: Clifton 2 Mill and Dam, Pacolet River, SC (Tom Augspurger, USFWS)

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Executive Summary: Impounded reaches behind dams can trap and accumulate sediments through time. In some cases, those sediments can accumulate contaminants, and at high concentrations those contaminants can have adverse toxicological effects in-place and upon movement downstream. We evaluated the potential for sediment contamination within the impoundment created by Clifton 2 Mill Dam on the Pacolet River, Spartanburg County, South Carolina. A tier 1 review of existing information on pollutant sources, similar to an environmental audit, was conducted. Searches of State and federal pollutant source databases identified hazardous waste sites, surface water discharges, landfills and other potential pollutant sources in the assessment area of the Clifton 2 Mill Dam (which we defined as one mile on each side of the Pacolet River, from the dam upstream to Blalock Reservoir). Reviews of State files for these facilities indicated that only the Auriga Polymers plant in Spartanburg warranted additional sediment quality evaluation due to documented releases of DowTherm A (a commercial heat transfer fluid comprised of diphenyl oxide and 1,1-biphenyl), and various solvents including 1,4-dioxane and chloroform. Fortuitously, recent sediment quality data were available to facilitate an expanded evaluation.

The SC Department of Health and Environmental Control (DHEC) State and Federal Site Assessment Section provided results of 2012 sediment sampling of the Pacolet River including the entire assessment area (as well as upstream and downstream). There were three sediment samples within the Clifton 2 Mill Dam impoundment among 34 samples from the Pacolet River. Sediment analyses included elemental contaminants, organochlorine pesticides, polychlorinated biphenyls, polycyclic aromatic hydrocarbons (PAHs), and volatile organic compounds; none were present at levels of toxicological significance. Concentrations were similar or higher downstream of the dam.

Sediment probing at 44 locations within the impoundment, and quantitative particle size determination of seven samples, indicates the bed material upstream of the Clifton 2 Mill Dam is dominated by fine to coarse sand with little potential to bind pollutants and therefore of little concern from a chemical pollutant standpoint. There are two small areas of silt accumulation between the dam and State Road 59 (about 350-feet), 10- to 25-feet from each bank and 1-2.5 feet deep. The deposits appear relatively recent. The left bank silt deposits were in the area SC DHEC sampled; our review of their data indicates pollutant concentrations are below levels of concern.

For site development or restoration planning (including potential dam removal), no additional sediment characterization is needed to support an inference that movement of the impoundment sediments downstream would be of no toxicological concern. However, three important administrative issues should be further addressed in site development or restoration planning. First, development interests need to follow-up with SC DHEC to ascertain their final action toward the Clifton 2 Mill. Based on their initial review, the SC DHEC State and Federal Site Assessment Section anticipates recommending no further action on the Clifton 2 Mill at the federal and state levels, and those determinations and concurrences are expected by late September 2012. Second, the SC DHEC recommended consideration of additional dam tailrace sediment samples for PAH analyses which may facilitate interaction with the SC DHEC Brownfields program, an option for this site's development or restoration. Third, we documented SC Department of Transportation Hydraulic Design Support Section concerns with removing sand from the area between the dam and Clifton-Glendale Road over impacts to the structural integrity of the bridge there. Because dam removal could be anticipated to change the dynamics of sand transport in the area, this concern should be pursued in advance of site development planning if dam removal is contemplated.

Introduction

Dam removals have re-established important natural resource and recreation benefits associated with riverine systems throughout the country. One issue to consider in evaluating the costs and benefits of dam removal is the chemical nature of the sediments accumulated behind the dam. The degree of the concern is a function of site-specific pollutant loading based on age of the dam, current and historic landuses, pollutants discharged into the watershed, and the amount and type of accumulated sediment. The U.S. Fish and Wildlife Service (USFWS) was asked to conduct a tier 1 evaluation of potential pollutant sources to the impoundment created by the Clifton 2 Mill Dam, Pacolet River, Spartanburg County, South Carolina. Our evaluation is intended to assist Spartanburg County Parks which is gathering information to make a recommendation to Spartanburg County Council regarding the suitability of the site for purchase and development into a river-based park (which could include dam removal). Spartanburg County Council will have the final say on any proposal from Spartanburg County Parks. This information on sediment quantity and quality is intended to help inform the process.

The Clifton 2 Mill Dam (34^{o}58'45"N, 81^{o}48'56"W) (Figures 1 through 3) is a chevron-shaped stone dam about 375-feet long and about eight to 10-feet tall. Built in the 1880s, the dam has created a small impoundment on the Pacolet River, which is about 250 to 300 feet wide upstream of the dam (the river is about 100 to 200 feet wide downstream of the dam). The extent of impoundment is less than one river mile as the Clifton 1 Mill Dam is 0.9 river miles upstream of the Clifton 2 Mill Dam. The Converse Dam is two miles upstream of the Clifton 2 Mill Dam.

The Clifton 2 Mill is parallel to the Pacolet River with its west exterior wall forming the eastern (left) bank of river. The dam's tailrace is located on the left side of the dam and runs north to south for about 870 feet before rejoining the Pacolet River. The mill buildings are in the process of demolition for brick and lumber salvage. The dam is no longer used for the mill, but it is intact. In 2007, the gates deteriorated and the impoundment was dewatered (Figures 4 through 6) over a period of about two years until gates were replaced (Scott MacDonald and George Fields, pers. comm.). From these figures and aerial images during this period (Figures 7 and 8), it is apparent that the river bottom near the dam is comprised predominantly of sand, consolidated enough to walk-on when dry, and that much substrate was scoured from the impounded reach during the period when the gates were open.

The Clifton 2 Mill structure recently included the original 160,000 square feet, 4-story spinning and weaving building built in 1888 on the east bank of the Pacolet River perpendicular to the stone dam. The east portion of the dam directs water to a millrace that runs under a hydroelectric facility on the south end of the mill. Mill deconstructed is on-going; as of late September 2012, only about one-third of the original mill building was still standing. Our assessment focuses only on the potential for sediment contamination rather than the overall environmental status of the mill property, but we note that a 1995 environmental audit of the mill revealed no environmental concerns (Law Engineering 1995).

Our tier 1 sediment evaluation is a review of existing information on pollutant sources, similar to an environmental audit. Existing data, records, files, and reports are reviewed and synthesized. The remainder of this report presents the methods, results, and recommendations from the tier 1 assessment.

Figure 1. Clifton 2 Mill and impoundment, Pacolet River, SC. Photo facing downstream from SR 59 (Clifton Glendale Road) (photo from SC DHEC)

Figure 2. Clifton 2 Mill and impoundment, Pacolet River, SC. Photo facing east from Goldmine Road (SR 108) (July 14, 2011 photo from Lynnette Batt, American Rivers)

Figure 3. Clifton 2 Mill and dam, Pacolet River, SC. Photo facing upstream from right bank (June 7, 2012 photo from Tom Augspurger, USFWS).

Figure 4. Clifton 2 Mill Dam, Pacolet River, SC, during gate replacement and dewatering (August 3, 2007 photo provided by Scott MacDonald).

Figure 5. Clifton 2 Mill Dam, Pacolet River, SC, during gate replacement and dewatering (August 3, 2007 photo provided by Scott MacDonald).

Figure 6. Clifton 2 Mill Dam, Pacolet River, SC, during gate replacement and dewatering (July 30, 2007 photo provided by Scott MacDonald).

Figure 7. Pacolet River at Clifton 2 Dam during 2007 gate replacement and dewatering (image from Bing Maps).

Figure 8. Pacolet River at Clifton 2 Dam during 2007 gate replacement and dewatering (image from Bing Maps).

Methods

There are no regulations or standards that dictate the approach to be used in evaluating potential sediment contamination at dam sites. However, there are pertinent well-established procedures aimed at guiding evaluation of the potential for contaminant-related impacts from sediments proposed for dredging. The joint U.S. Environmental Protection Agency and U.S. Army Corps of Engineers (1998) technical guidance manual on evaluation of dredged sediment was used to guide our evaluation of dam sediment contamination potential with additional guidance from sediment assessment manuals (MacDonald and Ingersoll 2002a, 2002b).

The USEPA/USACE Inland Testing Manual employs a tiered approach to evaluation of the potential for contaminated sediment impacts. Evaluations start with a tier 1 assessment (using readily available existing information to assess the potential for a contaminated sediment concern) and proceed in a step-wise fashion to more intensive data collection only to the extent necessary. In other words, all assessments start with tier 1; they may end there or continue to higher tiers if additional data are needed to guide the management decision. In general, absence of pollutant sources would indicate little need for aggressive work to characterize any potential contaminants. Likewise, any proposed sampling should be guided by identification of specific issues identified in the tier 1 review.

Our tier 1 assessment started with database searches to examine the potential for contaminant inputs to the impounded reach. We chose an assessment area defined as the stream-reach impounded by the dam, plus a one-mile buffer laterally and upstream. The Clifton 2 Dam is 8.7 river miles downstream from Lake Blalock (H. Taylor Blalock Reservoir) (35^{o} 03’ 09”N 81^{o} 51’ 49”W) which was constructed in 1983 with a 70 feet high dam; based on its size and age, the Lake Blalock Dam constituted the upstream extent our assessment area. This approach is consistent with the American Society of Testing and Materials *Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process* (ASTM 2005, 2008). Methods were similar to those of our previous studies (Augspurger and Cantrell 2004, Augspurger et al. 2007, Augspurger and Ward 2008, Augspurger 2009, USFWS 2006, 2011).

We examined databases and files maintained by the South Carolina Department of Health and Environmental Control (SC DHEC) and federal natural resource management agencies. Databases reviewed included those in the data directory for the SC DHEC Shared and Integrated Geographic Information System, the USEPA’s *Envirofacts Database* (facilities with air and water waste discharge permits, solid or hazardous waste sites, and facilities handling hazardous materials), USEPA’s (2010) Facility Registry System (FRS) which identifies facilities or sites subject to environmental regulations or of air, water, and waste interest, and online databases administered by the SC DHEC Bureau of Land and Waste Management (SC BLWM) and the SC Bureau of Water (SC BW). Data layers related to pollutant sources were reviewed for our assessment area. Data within *Envirofacts* and State databases were searched for Spartanburg County with sites then screened-in or screened-out for further review based on specific locations. Collectively, these mapping tools and databases retrieved known information from the following primary sources (with the administrative contact listed in parentheses)

CERCLIS Sites (known or suspected unregulated waste sites) (USEPA)
National Priorities List (Superfund Sites) (USEPA)

Resource Conservation and Recovery Act Sites (RCRA, USEPA)
(hazardous waste generation, transport, disposal)
Permit Compliance System (PCS) Sites (USEPA)
(NPDES, surface water discharge sites)
Air Facility System Sites (AFS, USEPA)
Toxic Release Inventory (TRI, USEPA)
Mining and Solid Waste (SC BLWM)
Registry of Conditional Remedies (SC BLWM)
SC Underground Storage Tank Registry (UST, SC BLWM)
Permitted Agricultural Facilities (SC BW)
Leaking Underground Storage Tanks (LUST, SC BLWM)
Mine Points (SC BLWM)
Formally Utilized Defense Sites (FUDS, SC BLWM)
Compliance and Enforcement Sites (SC C/E, SC BLWM)
Hazardous Waste Treatment, Storage and Disposal (SC TSD, SC BLWM)
Solid Waste Landfills (SWLF, SC BLWM)
SC National Pollutant Discharge and Elimination Sites (SC BW)

A geographic information systems (GIS) map was made for the Clifton 2 dam assessment area which notes the proximity of pollutant sources to the impoundment upstream of the dam. For facilities located within the one-mile assessment area, individual State files were reviewed. Sites along major tributaries to the assessment area were also assessed. File reviews gathered available information on pollutants discharged from the facilities, potential contaminant pathways from facilities to the rivers or creeks upstream of the dam, and environmental monitoring data for the facilities.

We reviewed environmental studies for the Pacolet River basin prepared by others with an emphasis on water and sediment chemistry. We also conducted a reconnaissance of the site.

Results

Database Searches and GIS Mapping

Figure 9 depicts potential pollutant sources identified using GIS data obtained from USEPA and SC DHEC within the one mile assessment area (shaded purple) on either side of the Pacolet River upstream of the Clifton 2 Mill Dam extending through the small impounded reach and upstream to Lake Blalock. Also, sites within a mile of named tributaries were shown. For each site identified within the assessment area and in close proximity to tributary streams, information available in online databases (including the respective USEPA and SC DHEC sources listed above) was compiled to determine the need for additional file review. Table 1 lists facilities identified, the facility type, and a rationale for whether they were retained for further assessment via file review and interviews. In addition to sites listed in Table 1, three above ground storage tank sites, 30 SC Compliance and Enforcement sites, and 20 leaking underground storage tanks were eliminated due to distance from the dam and low likelihood to negatively affect sediment quality at that site (Appendix A). If sufficient information was not available in public databases or online records, sites located within the assessment area were retained for further assessment.

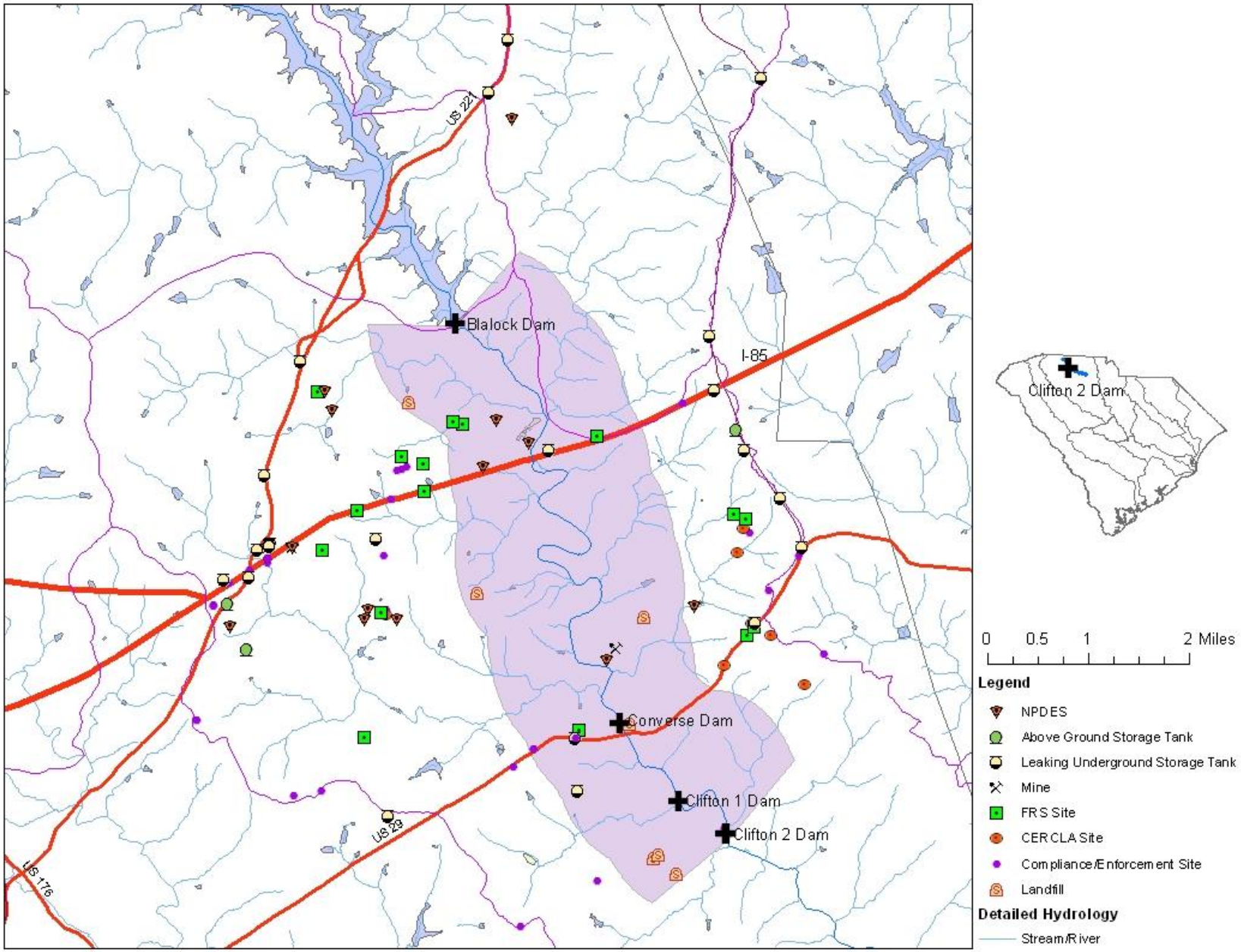

Figure 9. Sites with sediment pollution potential identified in and near buffer (shaded purple) of Clifton 2 Mill Dam impounded area.

Table 1. List of Facilities Identified in Database and Online Searches within the Pacolet River Assessment Area for the Clifton 2 Dam

Site Name	**Facility Type (ID)**	**Other Site Info**	**Site Retained** (Yes/No)	**Rationale**
Sites within the 1 mile buffer Pacolet River (between the Clifton 2 Dam upstream to Lake Blalock)				
Auriga Polymers Inc. (Former Hoechst Celanese); INVISTA, S.a.r.l. C&D	RCRA (SCD056811367) TRI (29304HCSTI85AT) AFS (4508300345) PCS (SC0002798) SWLF (423312-1901)	Active	Yes	Plastics and resin; non-cellulosic fiber manufacturing facility with surface water release. Major NPDES permit - limits for dozens of organic compounds as well as routine water quality parameters. On-site active construction and demolition (C&D) debris landfill.
CR Brands Inc	TRI (29307CRBRN24LDC) TRI (29301CHMPR141VE)		No	Soap/detergent manufacturing. No surface water discharge. Air fugitive primary release (glycol ether)
Johns Manville	TRI (29307JHNSM995MT) AFS (4508300344) PCS (SCR003392)		Yes	Non-woven fabric mill; plastics and resin manufacturing. Primarily air releases (formaldehyde). No point release to surface water. The facility is located next to Auriga Polymers, Inc.
Hagner Future Film 2000 (Closed)	AFS (4508300376)		No	Plastic film sheet manufacturing. Primarily air releases of volatile organic compounds (VOCs). No surface water release.
Community Cash Warehouse	SC C/E (SCR000003392)		No	EPA Envirofacts website indicates facility is outside of watershed
Clover Yarns Inc	SC C/E (SCD987587474)		Yes	Industrial site adjacent to the Clifton 2 Dam
A&E Remanufacturing Axles and Struts	SC C/E (SCR000000083)		No	North American Industry Classification System (NAICS) code is for soybean farming
Chapman Grading and Concrete (Sand Plant 6)	Mine (I-01081) SWLF (422908-1304)		Yes	River sand mining. Co-located with the active Robert Chapman Short Term C&D landfill (multiple units).
I-85 Associates	LUST (SC0000074301)	Site 08067	No	3 underground storage tanks (UST) abandoned in 1993 (2 gas, 1 diesel); all closed via removal from ground (completed in 1999)

Site Name	Facility Type (ID)	Other Site Info	Site Retained	Site Name
Spartanburg Co. School Dist. 3	LUST (SC0000069607)	Site 12635	No	2, 100-gal gasoline UST leaks in 1991; removed 1999
Littlejohn	LUST (SC0000067998)	Site 14631	No	8 USTs (2 kerosene, 6 gasoline) closed via removal from ground
Cliffdale Rd LCD&YT Landfill	SWLF (422683-1701)	Active	Yes	No info online
Bud Arthur Bridge Rd Landfill	SWLF (422484-1301)	Inactive	Yes	No info online
Converse Short Term C&D (1)	SWLF (422908-1301)	Inactive	Yes	No info online.
Converse Short Term C&D (2)	SWLF (422908-1302)	Inactive	Yes	No info online.
Converse Short Term C&D (3)	SWLF (422908-1303)	Inactive	Yes	No info online.
Inert Disposal Site (J. David Moore)	SWLF (no ID provided)	Inactive	Yes	No info online.
Sites near tributaries to Pacolet River (between the Clifton 2 Dam upstream to Lake Blalock)[1]				
Advanced Environmental Options Inc.	TRI (29307GLTXN25STA)	Inactive	No	Facility closed; VOC air releases between 2002-2006; no surface water discharge
Ameron Fiberglass Pipe Div	RCRA (SCD030089395) AFS (4508300203) TRI (29302MRNFB2400C)		No	Pipe and fitting manufacturing; inactive. Air and offsite waste transfer (1988-97); organic chemicals of concern; no surface water discharge
Dot Packaging Group Inc. PrintPak Div.	TRI (29304PRNTPI85AT) AFS (4508300215) RCRA (SCR000074799)		No	Printing; die cut paper and board manufacturing. Primarily air releases (methyl ethyl ketone and toluene) between 1987-2010.

Site Name	Facility Type (ID)	Other Site Info	Site Retained	Site Name
Freedom Textile Chemical Co.	TRI 29330CHMCRHIGHW) PCS (SCR002922) AFS (4508300250) AFS (4508300281)		No	Soap and detergent, surface agent, basic chemical manufacturing. Primarily air release and offsite transfer. Surface water release via stormwater permit only.
Glo Tex Advanced Environ Options	TRI (29307GLTXN25STA) AFS (4508300296)		No	Plastic and resin manufacturing. Closed. TRI – all air releases (organics) between 2002-2006.
Health-Tex Inc.	RCRA (SCD982125486) TRI (29330HLTHTLINDE) SCSF (SCD982125486)		No	Knit fabric mill. Primarily air releases (formaldehyde) and offsite transport. State lead SC Superfund site. No surface water release. Groundwater VOC plume discharging to tributary to Pacolet River. Distance from dam and nature of VOCs unlikely to present threat.
Lubrizol Advanced Materials	RCRA (SCD069324747) TRI (29302SPCLT195BR) PCS (SCG250228) PCS (SCR000208) AFS (4508300069)		No	Organic chemical, plastics and resins, surface active agent manufacturing. Minor air release (NO_2, TPM, SO_2, VOCs). Surface water releases to Peters Creek (tributary to Pacolet River) reported in 1987 (formaldehyde), 1991-1992 (glycol ethers), and 2005 (diethanolamine). No point source discharge.
Omega Chemicals Inc	RCRA (SCR000768739) TRI (29330MGCHM5077S) PCS (SCR000577) AFS (4508300259)		No	Industrial organic chemical manufacturing. TRI reported releases of diethanolamine, diethyl sulfate, epichlorohydrin, and propylene oxide below threshold. Permitted SO_2 air release. Surface water release via stormwater permit only.

Site Name	Facility Type (ID)	Other Site Info	Site Retained	Site Name
RR Donnelley and Sons Co.	RCRA (SCD000613224) TRI (29302RRDNNJONES) PCS (SCR002479) SC C/E (SCD000613224)		No	Commercial printing. Surface water discharge between 1988-99 (copper, toluene, xylene) to Peters Creek (tributary to Pacolet River). 1996-2010 stormwater permit.
Sherwin Williams Spartanburg	RCRA (SCD078067139) TRI (29307SHRWN178DA) AFS (4508300311)		No	Closed paint and coating manufacturing facility. TRI releases primarily offsite (organics); no surface water release.
Stowe Woodward	RCRA (SCD987582665) TRI (29303STWWDI85AT) PCS (SCR000165) SC C/E (SCD987582665) SC C/E (SCN000000077)		No	Rubber products manufacturing. Permanently closed. Primarily air releases (lead and zinc in 2001-2004) and offsite transfer. Surface water release via stormwater permit only.
T Glenn Easler Grading & Landscaping (SHA lane mine)	Mine (GP1-001438)		No	Sand mine. Unlikely to present threat due to inert nature of material and distance from Pacolet River.
A-Chem Corporation	SCSF (SCD030088918) SC C/E (SCD030088918)	State lead	No	VOC groundwater plume from above ground tanks/other discharging to tributary to Pacolet River. In monitoring/remediation phase. Distance from dam and nature of VOCs unlikely to present threat.
Bunche, Ralph School	SCSF (SCS123456821)		No	No info online. Site > 1 mile from Pacolet River.
Davis Coin Laundry Site	SCSF (SCS123456877)	State lead	No	Petroleum and VOC groundwater release in assessment/monitoring phase. Distance from dam and nature of VOCs unlikely to present threat.

Site Name	Facility Type (ID)	Other Site Info	Site Retained	Site Name
Grant's Textiles Inc.	SCSF (SCS123456957)		No	No info online. Site > 1 mile from Pacolet River.
Specialty Industrial Products Inc	SCSF (SCD987577491)	EPA lead	No	Groundwater VOC release. Facility has mixing zone agreement with Bureau of Water. Distance from dam and nature of VOCs unlikely to present threat.
Unisphere Chemical Corp	SCSF (SCD069324747	State lead	No	Groundwater VOC release. Distance from dam and nature of VOCs unlikely to present threat.

[1] In addition to sites listed above, 3 above ground storage tank sites, 30 SC C/E sties, and 20 LUST sites were eliminated due to distance from the dam and low likelihood to negatively affect impounded sediment quality.

Based on the available information from USEPA and State databases and other online public records, eleven sites (Figure 10) were retained for evaluation via detailed file review including: Auriga Polymers Inc (former Hoechst Celanese) and associated INVISTA construction and demolition (C&D) landfill, Johns Manville, Clover Yarns Inc., Clifton Mill Lofts Sand Mine, Robert Chapman C&D Landfill, Cliffdale Road Land Clearing Debris and Yard Trash Landfill, Bud Arthur Bridge Road Landfill, Converse Short Term C&D Landfills 1, 2 and 3, and the J. David Moore Inert Disposal Site. Of these sites, most were retained due to lack of available database information. Three sites, Auriga Polymers and the proximate Johns Manville Facility and the historic Clover Yarns Inc. operation, were retained based on potential to be a pollutant source of concern (due to proximity to impounded sediments or the nature of the facility operation).

To further evaluate the facilities identified as potential pollutant sources of concern by the database searches, freedom of information requests were placed to the SC DHEC to identify available files. USFWS staff conducted file reviews on June 6, 2012 (SC DHEC's Region 2 Environmental Quality Control Office in Spartanburg) and July 5, 2012 (SC DHEC's Bureau of Land and Waste Management Office in Columbia). Facility-specific summaries and analysis of the potential for pollutant releases from the operations to affect sediment quality in the impounded reach of the Clifton 2 Dam follow:

Bud Arthur Bridge Road Landfill This site is also known as the Haskell-Sexton Short-term Construction and Demolition (C&D) Landfill (Solid Waste file 422484-1301) at 1635 Bud Arthur Bridge Road. Mr. Haskell Sexton of Sexton Construction Co. applied on March 9, 1995 for a construction and demolition debris landfill on 0.628 acres within a 24 acre parcel owned by Mr. Jack Clubb. The SC DHEC issued the permit May 4, 1995. The application requested a 14-day use for 80,000 tons of block, brick, and cured asphalt related to demolition of a schoolhouse. According to maps in the site file, the debris was to be placed into a gully 500 feet from the Pacolet River (as opposed to the SC DHEC GIS-layer coordinates depicted on Figure 10). File notes from a 1996 site visit indicate the landfill was no longer in use, but not formally closed. Notes from a January 12, 1997 site visit indicated illegal dumping of yard waste, lumber, antifreeze containers, paint cans, and windows. Between August 8, 1996 and August 14, 1997, SC DHEC sent letters to site owners and landfill operators indicating the need for site controls and closure. There is no record of formal closure. Due to its location and small size, this site requires no further consideration with regard to potential impacts to sediment quality at the Clifton 2 dam.

Cliffdale Road Land Clearing Debris and Yard Trash Landfill According to Stephanie Murdock of SC DHEC's Region 2 Environmental Quality Control Office in Spartanburg (May 23, 2012 telephone conversation with Tom Augspurger of USFWS), this is a class 1 landfill which receives only limbs, brush and other yard waste. Due to the nonhazardous nature of the material handled at this landfill, the site requires no further consideration with regard to potential impacts to sediment quality at the Clifton 2 dam.

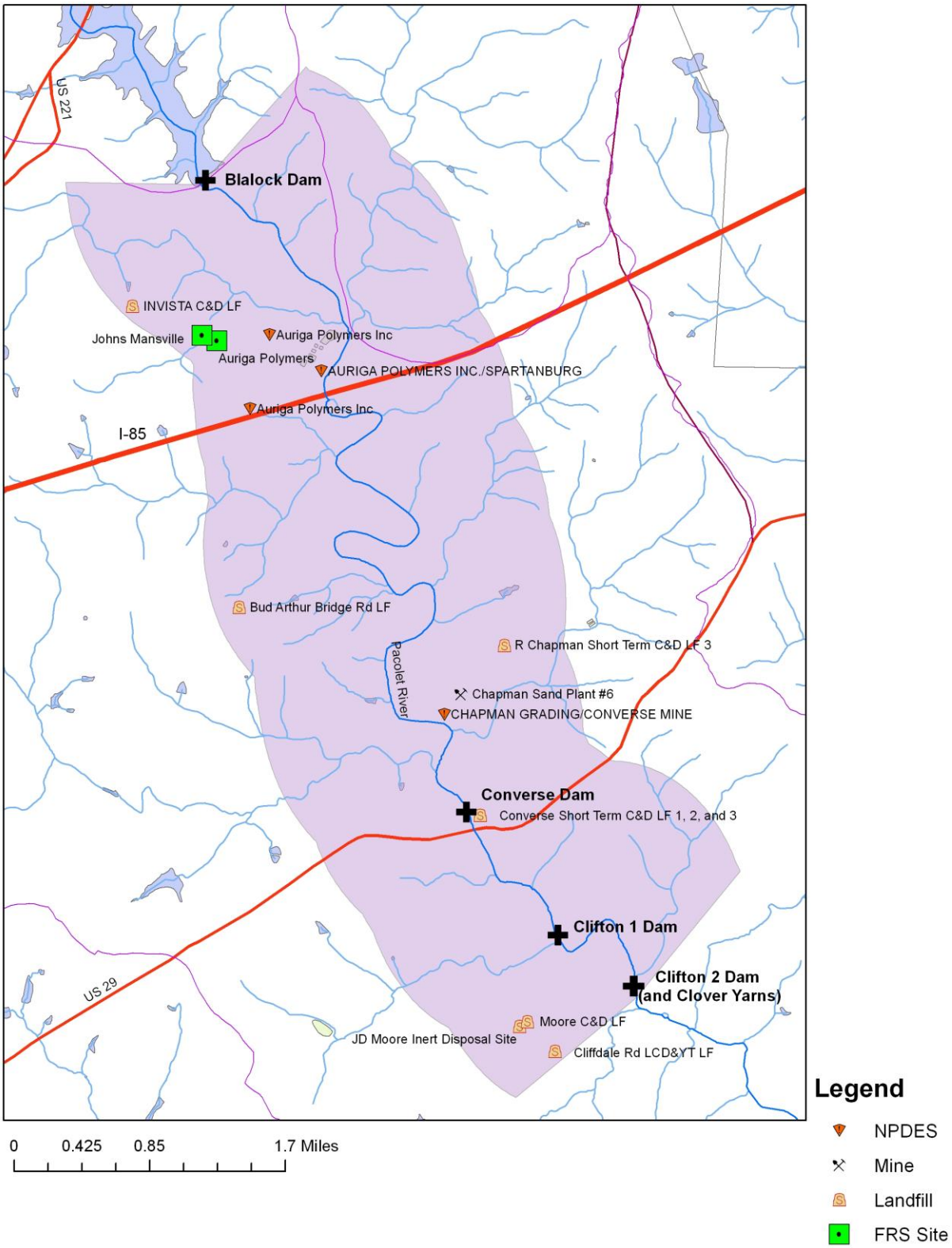

Figure 10. Sites with sediment pollution potential retained for additional review relative to Clifton 2 Mill Dam impounded area.

Clifton Mill Lofts Sand Mine A permit to mine sand from the Pacolet River near the mill was applied for but never issued. Mr. David Sawyer bought the mill in 2004 from Best Machinery Movers and Erectors with the intent of developing the mill for loft apartments and the dam for hydroelectric power generation. Habersham Mills became Clifton Mill Lofts, LLC, the entity which applied to SC DHEC for a permit (between August 30 and October 15, 2007) to mine sand from a 1,700 feet section of the Pacolet River from the sediment surface to a depth of eight feet below the existing river bottom. The proposal was received by SC DHEC which routed the application materials for public comments (file ID I-001791) as well as review of other branches of State and federal governments. On April 30, 2010, the applicant notified SC DHEC that they no longer owned the property, would no longer need the permit, and withdrew the application.

From a pollutant source perspective, the proposed sand mine requires no further consideration. The application materials do augment understanding of the physical nature of sediments accumulated behind the Clifton 2 Mill Dam, providing additional support to the observation that the material has been predominantly sand. From an overall site development perspective, the interagency permit review provides informative detail to consider. In particular, a March 12, 2008 email from Mr. Charles K. Smoak (SC Department of Transportation (DOT) Hydraulic Design Support Engineer) to Ms. Pam Bergstrand (SC DHEC Mining and Reclamation Section) indicated concerns with sand removal in this area. Mr. Smoak's email read in part that:

> "…the SC DOT has no objections for mining sand below the dam located south of the bridge on secondary Road S42-59. However, the SC DOT does have objections for any sand mining in the area above the dam and below the bridge. Due to the structural type and design of the bridge, sand mining in this area would result in weakening the structural integrity of the bridge. For this reason the SC DOT would ask that no sand mining be allowed in the area shown hatched on the attached layout."

Because dam removal could be anticipated to change the dynamics of sand transport in the area, this concern should be pursued as part of overall site development planning.

Clover Yarns This file (SCD987587474) relates to an assessment of the potential of the mill to be a source of pollutant releases to the environment, including the Pacolet River downstream of the dam. The files provide the SC DHEC Federal and State Site Assessment Section's rationale for evaluation of this site as part of their Spartanburg Area Initiative, an investigation of several potential pollutant sites in the Pacolet River drainage near Spartanburg. Under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986 (SARA), the Federal and State Site Assessment Section is conducting a "Pre-CERCLIS Site Assessment (PSA)" at the Clifton 2 Mill. The PSA file material includes permit searches (retrieving permit data for four asbestos removal actions and one inactive "LWM-HW Notification of Regulated Waste Activity") and collection of two water samples and six sediment samples from the Pacolet River upstream and downstream of the mill. The samples will be used to determine if there has been a pollutant release to the environment and to evaluate the site's waste characteristics for the Hazard Ranking System scoring that will determine the priority for future assessment of the site. The sample results and the SC DHEC action toward the site PSA are especially relevant to the tier 1 evaluation of sediment quality and in site development considerations.

Spartanburg Area Initiative sediment sampling results were provided by Mr. John McInnis, Manager, State and Federal Site Assessment Section, and we reviewed data for the few samples near the Clifton 2 Mill Dam (Figure 11 and Table 2). There are no federal or South Carolina sediment quality criteria or standards, but the threshold effects concentrations (TECs) and probable effects concentrations (PECs) from MacDonald et al. (2000) are helpful in assessing the significance of the SC DHEC sediment chemistry results. While no regulatory implications are inferred in our use of TECs and PECs, sediment quality guidelines like these have been useful in risk assessments conducted by various government and non-government organizations (Wenning et al. 2005) and they have been the basis for sediment quality standards and screening values elsewhere (MacDonald and Ingersoll 2002a, 2002b, MacDonald et al. 2003, Augspurger 2012).

The TECs are concentrations of contaminants in whole-sediment below which adverse effects to sensitive aquatic organisms are not expected to occur; therefore Clifton 2 Mill Dam sample results less than the TECs will be considered of no toxicological concern. The PECs are effect-based sediment quality guidelines established as concentrations of contaminants in whole-sediment above which adverse effects are expected to frequently occur (MacDonald et al. 2000); if sample results exceed these PECs, additional evaluation is warranted.

Table 2. Locations near the Clifton 2 Mill of sediment samples collected by SC DHEC in 2012.

Sample Site	Description	Latitude	Longitude
CMT-001	Confluence of Pacolet River and unnamed tributary on east bank, north of Clifton Glendale Road. Site is upstream (background) of potential mill influence	34.980308	-81.814865
CMT-002	Clifton 2 Mill pond near the dam where it enters into the mill's hydroelectric buildings	34.979135	-81.814849
CMT-003	Mill's tail race where it re-enters the river	34.977052	-81.813443
CMT-004	Pacolet River near the outfall of Spartanburg's wastewater treatment plant	34.970337	-81.802758
CMT-005	Pacolet River at the end of Hatchett Drive	34.962710	-81.789730

For the three samples collected within the impounded reach of the Clifton 2 Mill Dam, no chemicals exceeded the PECs and almost all chemicals were less than the TECs. No polychlorinated biphenyls (PCBs) were detected in the samples from the impounded area, and the only organochlorine pesticides detected were gamma-chlordane (0.32 µg/kg) and alpha-chlordane (1.8 µg/kg) which were less than their TECs. For heavy metals and metalloids (Table 3), only chromium (45 mg/kg) and nickel (24 mg/kg) at site CMT-002 adjacent to the mill marginally exceeded their corresponding TECs (43.4 mg/kg for chromium and 22.7 mg/kg for nickel). Similar levels of chromium and nickel were found in downstream sediments. All other metals were less than their TECs. None of the three samples collected within the Clifton 2 Mill Dam impoundment exceeded the TECs for polycyclic aromatic hydrocarbons (PAH) (Table 4). Concentrations of eight PAHs in the first sediment sample collected downstream of the mill and dam (CMT-003) exceeded the TECs.

Figure 11. Locations near the Clifton 2 Mill of sediment samples collected by SC DHEC in 2012. One additional sample (CM-005) is located in between this dam and the Clifton 1 Mill Dam (upstream) and additional samples (CMT-004, CMT-005, PM5003, PM5004 and PM5001) were collected further downstream.

Table 3. Elemental contaminants (mg/kg dry weight, or parts per million) in whole-sediment samples collected by South Carolina Department of Health and Environmental Control from the Pacolet River, February 2012. For each element, results are compared to threshold-effects concentration (TEC) guidelines of MacDonald et al. (2000) – values below which adverse effects to sensitive aquatic organisms are not expected to occur, and probable effects concentrations (PECs) – values above which adverse effects to sediment dwelling organisms may be expected. No samples exceeded the PECs. Only chromium and nickel at site CMT-002 (**highlighted**) slightly exceeded TECs and are unlikely of toxicological significance.

	Sample ID	As	Cd	Cr	Cu	Pb	Hg	Ni	Zn
Upstream of Clifton 2 Dam	CM-005	2	0.61 U	28	8.2 J	8.8 J	0.0074 J	10 R	34
	CMT-001	2 R	0.65 U	20 J	3.9 J	6.1	0.13 U	5.8	22 J
	CMT-002	4 R	1.2 U	45 J	16 J	21	0.23 U	24	80 J
Downstream	CMT-003	5.6 R	0.61 U	50 J	7.6 J	17 J	0.12 U	9.2	18 J
	CMT-004	5.4 R	0.57 U	35 J	13 J	7.1	0.11 U	6.7	28 J
	CMT-005	1.1 R	0.6 U	12 J	1.2 J	2.7	0.12 U	1.3 J	5.1 J
	PM5003	0.55 J	0.64 U	6 J	2.4 J	2.6	0.13 U	1.8 J	12 J
	PM5004	1.6 J	0.68 U	17 J	7.6 J	7.5	0.14 U	8.3	30 J
	PM5001	6.4 J	0.74 U	53 J	28 J	37	0.084 J	29	96 J
TEC Guideline Value		9.79	0.99	43.4	31.6	35.8	0.18	22.7	121
PEC Guideline Value		33	4.98	111	149	128	1.06	48.6	459

U - The analyte was not detected at or above the reporting limit.
J - The identification of the analyte is acceptable; the reported value is an estimate.
R - The presence or absence of the analyte cannot be determined from the data due to severe quality control problems. The data are rejected and considered unusable.

Table 4. Polycyclic aromatic hydrocarbons measured in whole-sediment samples collected by South Carolina Department of Health and Environmental Control from the Pacolet River, February 2012. All data are µg/kg dry weight (parts per billion). Results are compared to threshold-effects concentration (TEC) guidelines of MacDonald et al. (2000) – values below which adverse effects to sensitive aquatic organisms are not expected to occur, and probable effects concentrations (PECs) – values above which adverse effects to sediment dwelling organisms may be expected. No samples exceeded the PECs. Only the downstream samples exceeded the TECs (**exceedences of TECs highlighted**).

	Sample ID	Acenaphthene	Anthracene	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenzo(a,h)anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Phenanthrene	Pyrene
Upstream of Clifton 2 Dam	CM-005	240 U	240 U	240 U	240 U	240 U	240 U	240 U	240 U	240 U	29 J	240 U	240 U	240 U	33 J
	CMT-001	210 U	210 U	210 U	210 U	210 U	210 U	210 U	210 U	210 U	210 U	210 U	210 U	210 U	210 U
	CMT-002	440 U	440 U	75 J	440 U	120 J	440 U	440 U	85 J	440 U	130 J	440 U	440 U	440 U	440 U
Downstream	CMT-003	50 J	200 J	640	440	740	220 J	260	650	75 J	1500	61 J	320	1000	1100 J
	CMT-004	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
	CMT-005	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U
	PM5003	210 U	210 U	210 U	210 U	210 U	210 U	210 U	210 U	210 U	210 U	210 U	210 U	210 U	210 U
	PM5004	240 U	240 U	240 U	240 U	240 U	240 U	240 U	240 U	240 U	240 U	240 U	240 U	240 U	240 U
	PM5001	270 U	270 U	190 J	200 J	320	120 J	150 J	230 J	270 U	350	270 U	180 J	90 J	330
TEC Screening Value			57.2	108	150				166	33	423	77.4		204	195
PEC Screening Value			845	1050	1450				1290		2230	536		1170	1520

U - The analyte was not detected at or above the reporting limit.

J - The identification of the analyte is acceptable; the reported value is an estimate

There were 175 chemicals included in the analyses of the SC DHEC's samples, so their dataset is also useful in tracking the extent to which contaminants of concern at the Auriga Polymers / INVISTA site (see description below) may have migrated downstream in the Pacolet River. Contaminants of concern in groundwater at that site include DowTherm A (a commercial heat transfer fluid comprised of diphenyl oxide and 1,1-biphenyl), and solvents, including 1,4-dioxane and chloroform. No 1,1-biphenyl (<440 µg/kg), chloroform (<13 µg/kg), or other chlorinated organic solvents (<13 µg/kg) were detected in the Clifton 2 Mill Dam impoundment samples. The data for 1,4-dioxane all failed the quality control review and are considered unusable. The only other solvents detected were acetone (91 µg/kg at CMT-002) and methyl ethyl ketone (27 µg/kg at CMT-001) which are unlikely to be of concern at these concentrations. Phthalates, which could be associated with the feedstocks, products, or wastes from the facility, were less than method detection limits (<440 µg/kg).

MacDonald et al. (2000) and USEPA (2000) concluded that exceedence of PECs (by frequency or by magnitude) is frequently associated with sediment toxicity, but infrequent exceedence of TECs is not associated with sediment toxicity. The three sediment sample sites within the impounded reach of the Clifton 2 Dam are therefore considered by USFWS as toxicologically insignificant. The SC DHEC's Federal and State Site Assessment Section has the final say, however, on the outcome of the PSA and the next steps with regard to this site. In an August 7, 2012 telephone conversation, Mr. McInnis and Mr. Robert Cole (also with the SC DHEC State and Federal Site Assessment Section) indicated that they would prepare a report to USEPA and recommend no further action on the Clifton 2 Mill based on the analytical results from 2012. They anticipate USEPA's concurrence with their recommendation, at which point the site would be ranked within SC DHEC for its priority for state action, a ranking they anticipated as also of low priority. It was further anticipated that federal and State letters indicating the no further action status would be available by late September 2012. While not a component of their consideration of the site for federal or state remedial action, Mr. McInnis and Mr. Cole noted the limited extent of their sampling and the elevated PAH concentrations at the end of the tailrace; they suggested that any purchaser of the property consider additional sampling for PAHs in tailrace sediments and comparison to the screening values used in their Spartanburg Area Initiative data summary. Those additional data may facilitate interaction with the SC DHEC Brownfields program which is an option for this site.

Converse Short Term C/D Landfill 1 Chapman Grading and Concrete was permitted (Solid Waste file 422908-1301) by SC DHEC on August 13, 1999 to receive 17,000 cubic yards of "land clearing debris, hardened concrete, hardened or cured asphalt, bricks, blocks, and untreated / unpainted lumber that has not been in contact with lead-based paint or any hazardous constituents, petroleum products, pesticides, or other materials." The site is near the Highway 29 crossing of the Pacolet River off of Brooklyn Road. The landfill location is upstream of the Converse Dam and over 500 feet from river on the left bank. About ¾ of the site is outside the 100-year floodplain. The site file has records of 14 inspections between December 1999 and July 18, 2002 with no concerns. The SC DHEC issued a May 30, 2002 letter providing confirmation of compliance with all regulatory closure requirements and permit termination. Due to the nonhazardous nature of the material accepted at the landfill and its small size, this site requires no further consideration with regard to potential impacts to sediment quality at the Clifton 2 Mill Dam.

Converse Short Term C/D Landfill 2 Chapman Grading and Concrete was permitted (Solid Waste file 422908-1302) by SC DHEC on October 2, 2000 to receive 10,200 cubic yards of land clearing debris and construction debris adjacent to the Converse Short Term C/D Landfill 1 described above.

It was permitted for the same landfill materials as described above. Due to the nonhazardous nature of the material accepted at the landfill and its small size, this site requires no further consideration with regard to potential impacts to sediment quality at the Clifton 2 Mill Dam.

Converse Short Term C/D Landfill 3 Chapman Grading and Concrete was permitted (Solid Waste file 422908-1303, also called the Robert Chapman C/D Landfill) by SC DHEC on September 9, 2002 to receive 12,700 cubic yards of land clearing debris and construction debris adjacent to the Converse Short Term C/D Landfill 1 described above. The site file has records of 15 inspections between October 29, 2002 and December 15, 2003 with no concerns. A September 30, 2003 letter from SC DHEC notes that the "footprint area never received any wastes" and indicates the landfill is closed and permit terminated. Because this site was never used, it requires no further consideration with regard to potential impacts to sediment quality at the Clifton 2 Mill Dam.

Auriga Polymers Inc. (formerly INVISTA, formerly Hoechst Celanese) Previous releases of hazardous substances to the environment, historic and current wastewater discharge to the Pacolet River, hazardous materials handling, an on-site landfill, closed waste management ponds, and site clean-up investigations are all relevant to this facility's impact to the sediment quality in the Pacolet River. What is now Auriga Polymers Inc. was formerly known as Hercules, Inc., a manufacturer of dimethyl terephthalate (DMT). Hercules, Inc. became Hoechst Fibers in 1970 and eventually Hoechst Celanese. In 1998, Hoechst Celanese sold the facility to a subsidiary of Koch Industries which operated the plant under the name KoSa. Koch Industries merged KoSa with INVISTA (formerly DuPont Fibers) in 2004. The ownership changed from INVISTA to Auriga Polymers Inc. in March 2011. The 375 acre Spartanburg site consists of manufacturing areas, laboratories, wastewater treatment, boiler water treatment, and parking areas. This plant no longer manufactures DMT; it instead receives DMT from Wilmington, North Carolina, and mixes it with ethylene glycol in polymerization of polyester intermediates used in rigid packaging, technical fibers, textiles, and film. That process produces methanol as a byproduct which is sent to Wilmington to make DMT. The Spartanburg facility also has a process in which terephthalic acid is mixed with ethylene glycol to make polyester fiber, polyethylene terephthalate (PET) resins used in food and beverage packaging, and polyester film. While methanol is the co-product from the DMT-based process, acetaldehyde and l,4-dioxane are byproducts of PET polymerization. The facility also uses several metal compounds as catalysts.

The SC DHEC has directed past and ongoing assessment of the nature and extent of contamination and cleanup of the groundwater and source areas. Sampling has been conducted on the soil, groundwater, surface water and sediments. The primary contaminants of concern at the site are 1,4-dioxane, DowTherm A (a commercial heat transfer fluid comprised of 73% diphenyl oxide (DPO, or biphenyl ether) and 27% biphenyl (1,1-biphenyl, or diphenyl, or phenylbenzene)), and various chlorinated organic solvents including chloroform. Groundwater remediation began in 1996 with installation of extraction wells to remove groundwater for treatment and continues today (Environment and Infrastructure 1994, 1996a, SynTerra 2011, AECOM Environment 2011, 2012).

Because of the site's location, most of the groundwater plumes discharge to streams that surround the site, including Cherokee Creek and the Pacolet River (AECOM Environment 2010b, 2011). A historical data summary from remedial investigation work at the site includes 257 individual sample locations, most sampled several times from 1990 to 2010 for multiple contaminants (138,758 data points). For the contaminants of concern at the facility, we reviewed the surface water data for 12 monitoring sites in the Pacolet River, Cherokee Creek and tributaries. Data were available from

samples collected between 1999 and 2010. There were 263 sample results for 1,1-bihpheyl, and all were less than a 10 µg/L detection limit. There were 275 sample results for 1,4-dioxane which ranged from <10 to 409 µg/L; the only samples above the 10 µg/L detection limit were from stations SW-10 and SW-11 which are downstream of the wastewater discharge (and no samples were above 10 µg/L at these sites since 2008). There were 298 sample results for chloroform which ranged from <5 to 28.1 µg/L; the only samples above 5 µg/L were from station SW-12 (unnamed tributary to Pole Bridge Branch, south of I-85) which drains to the Pacolet River (AECOM Environment 2010a). Contamination detected in surface water is typically at concentrations less than state and federal standards so SC DHEC indicates these waters are safe based on current data (http://www.scdhec.gov/environment/FormerHoechstCelaneseSite/site_history.asp). Additional ecological impact studies are planned with an ecological study work plan in review as of June 2012 to follow-up on a 2011 assessment which noted sediment contamination and the absence of caddisflies (a water quality indicator species) near the plant (Glover 2011).

Other remedial actions include solvent capture prior to discharge to surface waters, removal of soil and sludge from the wastewater treatment plant impoundments and basins, and upgrade of the wastewater treatment plant. Source areas for groundwater contamination included five on-site industrial wastewater and sludge impoundments. The impoundments and underlying soils were found to be contaminated with 1,4-dioxane and other solvents (SEC Donohue, Inc. 1992). In 1992, the impoundments were proposed to be closed with the residual sludge incinerated and disposed of at a proposed on-site incinerator ash landfill (SEC Donohue and RUST International Corporation 1992, RUST Environment and Infrastructure 1993a, 1993b). In 1993, the company received the concurrence of SC DHEC that sludge remaining in the wastewater treatment plant basins was a non-hazardous waste suitable for landfilling (in lieu of incineration). The sludges were hence disposed of at the Palmetto Landfill (Wellford, SC, west of Spartanburg) which had previously been receiving other wastes from the Hoechst Celanese facility, such as polyester scrap, DMT, terephthalic acid, wood, paper, and cafeteria and general trash.

The on-site waste water treatment plant's discharge is another pollutant source. The treatment plant initially handled process wastewater and groundwater which was discharged to the Pacolet River under NPDES permit outfalls 002 and 001 SC0002798 issued in 1995 to handle 830,000 gallons per day. Plant overhauls have changed the nature of the waste received and the treatment and disposal processes (RUST Environmental and Infrastructure 1996b). Wastewater generated from the production process is now treated on-site in an aerobic biological wastewater treatment plant that consists of a) preliminary treatment via pre-chlorination, pH adjustment, grit removal and screening, b) equalization/diversion, c) two-stage activated sludge treatment, d) secondary clarification, e) effluent filtration, and f) disinfection and chlorine destruction. In addition to the wastewater treatment system, the production facility uses a distillation column to separate acetaldehyde and 1,4-dioxane from process wastewater. Recent discharge monitoring reports indicate the facility is typically meeting its permit limits although high concentrations of up to 5400 µg/L of 1,4-dioxane and 8.7 µg/L of chloroform are periodically discharged to the river (Brown and Caldwell 2012). Over the past two years, the facility has discharged between 0.3 and 1.6 million gallons per day of treated effluent. Eight toxicity tests of the effluent from outfall 002 between January 2010 and December 2011 indicate permit compliance and that the effluent was not toxic to sensitive aquatic organisms at concentrations three-times greater than allowed in the permit. The facility also has three stormwater permits with six outfalls to the Pacolet River or its tributaries.

The GIS database search also identified an on-site construction and demolition debris landfill (permit 423312-1201) at the Auriga Polymers Site, the files for which we reviewed. Located about 500 feet south of and draining to Cherokee Creek (a Pacolet River tributary), this approximately 7-acre landfill received building debris and soils as well as demolition material from the old DMT plant between 1994-2009 (Lockwood Greene Engineers 1994). The concrete from the production plant was tested to determine suitability for disposal at the landfill prior to placement. The landfill was closed in 2010 (Davis and Floyd 2009). The closed construction and demolition debris landfill does not require follow-up with regard to Pacolet River sediment quality.

In addition to the groundwater contamination and remediation (including source area remediation described above), other environmental issues associated with the INVISTA site include its status as a large quantity generator of hazardous waste and its regulation under the Resource Conservation and Recovery Act (RCRA). Self-reporting data lists 172 wastes generated at the site, including organic solvents like isopropyl toluene (cymene), methanol-glycol mix , dichloroacetic acid, acetone, chloroform and acetone mix, phenol and acetone mix, trichloroethane, phenol tetrachloroethane, DowTherm, sodium hydroxide, ethyl acetate, phosphoric acid, glycerin, sulfuric acid, hydrochloric acid, ammonium hydroxide, ferric chloride, and miscellaneous hazardous materials (lab pack wastes, evaporator bottoms, spills, waste oils, sludges, spent batteries, PCB ballasts, paint and thinner, paint chips, aerosol cans, waste mercury and mercury-containing devices). An October 4, 2002 compliance evaluation noted no concerns. An August 6, 2007 compliance evaluation noted 14 apparent RCRA violations with waste handling and record keeping which were referred to SC DHEC Bureau of Land and Waste Management's enforcement staff; the facility returned to compliance on September 8, 2008. A February 2011 compliance evaluation notes three waste labeling, handling and storage violations, and follow-up inspection by SC DHEC indicate these were addressed the same month. The RCRA permitted waste management activities do not merit follow-up with regard to Pacolet River sediment quality.

J. David Moore Inert Disposal Freedom of information requests resulted in no records of this site (which had no identification number or address in the GIS layer in which it was depicted) at either the Spartanburg or Columbia offices of SC DHEC.

Johns Manville Johns Manville Spartanburg Plant manufactures Spunbond mat which is a filament needle punched non-woven synthetic fabric. The basic Spunbond fabric is composed of polymers and additives and is used in roofing and industrial applications. The facility is a major source for hazardous air pollutants based on the magnitude of the permitted releases which include formaldehyde, acetaldehyde, particulate matter, carbon monoxide, nitrogen oxides, and sulfur dioxide. The Auriga Polymers, Inc. wastewater treatment plant described above treats sanitary and process wastewater from the Johns Manville plant.

Robert Chapman Landfill 3 This site (Solid Waste file 422908-1304) was permitted by SC DHEC on November 3, 2003 to receive 8,700 cubic yards of construction and demolition debris. The site file has records of 13 inspections between November 25, 2003 and April 30, 2007. A specific complaint that asbestos waste was being accepted was pursued by SC DHEC which concluded that no visible unauthorized materials were found. Following an October 26, 2005 letter from SC DHEC indicating the site was not properly closed, a July 11, 2006 notice of alleged violation for failure to properly close the landfill, and a January 9, 2007 civil penalty for administrative violations related to landfill closure, the permittee received SC DHEC's January 30, 2007 letter providing confirmation or compliance with all regulatory closure requirements and permit

termination. Due to the nonhazardous nature of the material accepted at the landfill and its small size, this site requires no further consideration with regard to potential impacts to sediment quality at the Clifton 2 Mill Dam.

Reconnaissance

Service Ecologists / Environmental Contaminants Specialists (Tom Augspurger and Thomas Rainwater) visited the Clifton 2 Mill Dam on June 7, 2012. The impounded reach, from the dam upstream to the extent of impoundment (the rocks downstream of Clifton 1 Dam) was traversed by canoe. With the exception of the mill, the local watershed is rural with open space and low density single family homes. There are no other structures, containers, or debris evident that would be a pollutant concern. At 44 sites, we sampled water depth, sediment depth, and nature of the sediments between the Clifton 2 and Clifton 1 dams (Figures 12a-c, Table 5).

Water depth and sediment probing was conducted with a surveying rod, marked in quarter-foot intervals. After the water depth was recorded, the rod (which has a conical brass tip) was pushed by hand as far as possible into the underlying sediment at which point another measurement (depth to refusal) was recorded. Qualitative descriptions of the sediment were recorded in the field (Table 5). We also collected sediments at seven locations to confirm our qualitative field classifications with quantitative laboratory sediment particle size determinations. Samples were collected with a petit ponar dredge, stored in plastic containers, and delivered to GeoTechnologies, Inc. of Raleigh, North Carolina which conducted the particle size analyses (Table 6 and Appendix B).

The deepest portion of the impoundment measured nine feet, and sediment depths (the differential between water depth and depth to refusal in Table 5) were equal or less than two feet in all but one location, near the dam. Sediments in the majority of the impounded reach are sandy, and bedrock with no depositional material is frequently encountered in the upper reaches of the impoundment. Site 35 (93% gravel and sand) and site 49 (96% gravel and sand) are from the center of the impoundment and characteristic of other sediments we classified in the field as gravel and coarse sand – the dominant sediments in the impoundment.

There are two areas of fairly substantive silty-sand accumulations between the dam and Clifton-Glendale Road (SR 59), 10- to 25-feet from each bank over a distance of about 350-feet. Along the mill foundation, these deposits were about 1.5 to 2.75-feet thick (e.g., sites 30, 31, 32). These sediments are not very deep, and therefore likely consist of recently accumulated material. Further evidence of their recent origin is provided by the photos from the period of impoundment dewatering around 2007 (Figures 4 through 8) in which it is apparent that the material at that time is consolidated enough to walk on – the silty sands in the area at present likely accumulated after closing off of the sluiceway which may have created a quiescent area along the left side of the river near the mill. Samples from these areas near the shore (e.g. 32, 42, 39) are still dominated by sand, but they have a percentage of fine material (silt plus clay fraction) in excess of 10% and up to 35% and therefore have greater potential to bind pollutants. We confirmed the narrow distance from shore of these deposits by probing to find the edge of the silty sands; for example sites 43 and 35 are just slightly further from shore and dominated by sand and gravel. Upstream of the bridge, even the samples adjacent to the shore are predominantly sand (e.g., site 53).

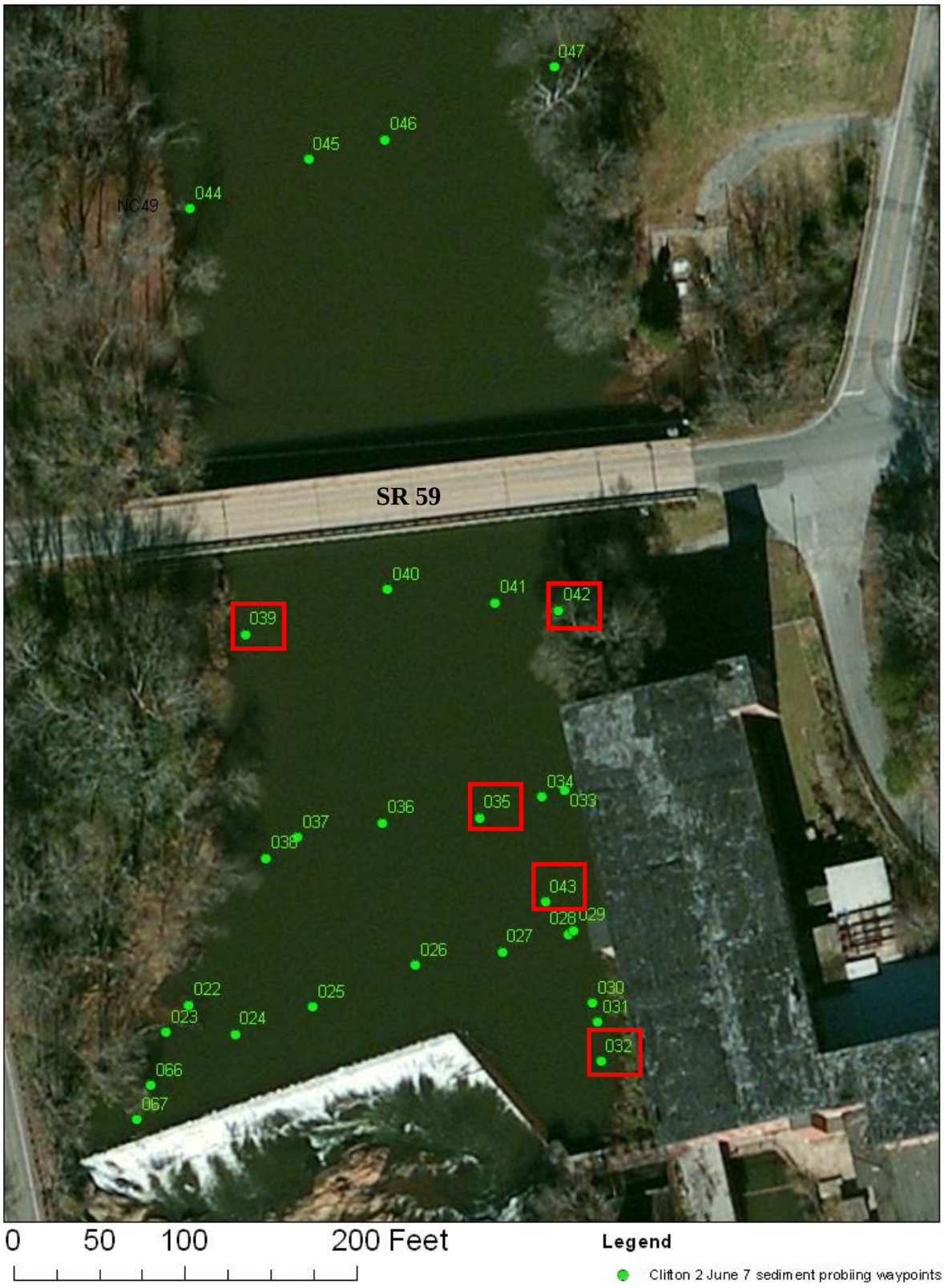

Figure 12a. Clifton 2 Mill Dam impounded area sediment characterization sites, June 7, 2012. Sites outlined in red are those for which sediment particle size was determined (Table 6).

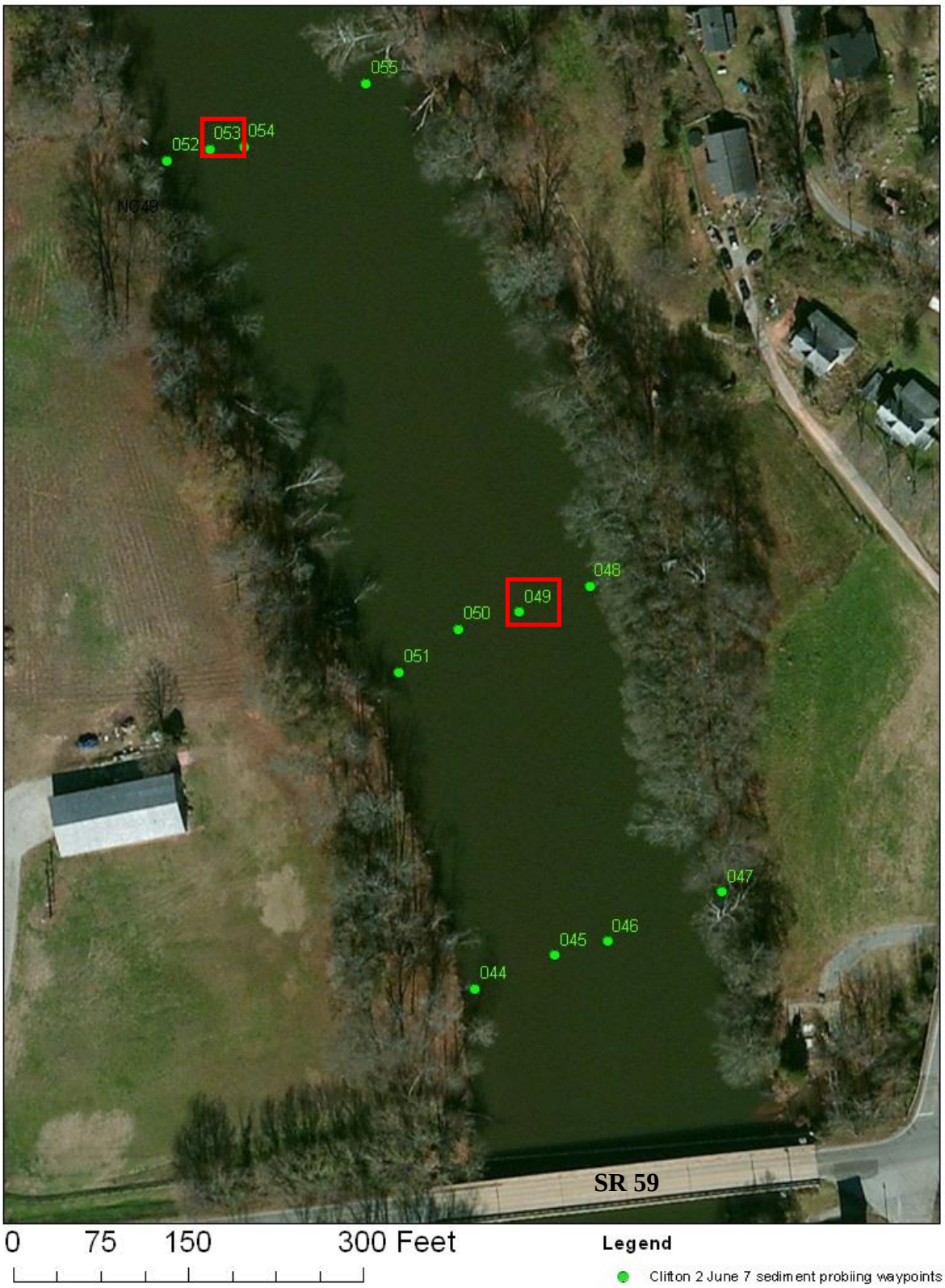

Figure 12b. Clifton 2 Mill Dam impounded area sediment characterization sites, June 7, 2012 Sites outlined in red are those for which sediment particle size was determined (Table 6)

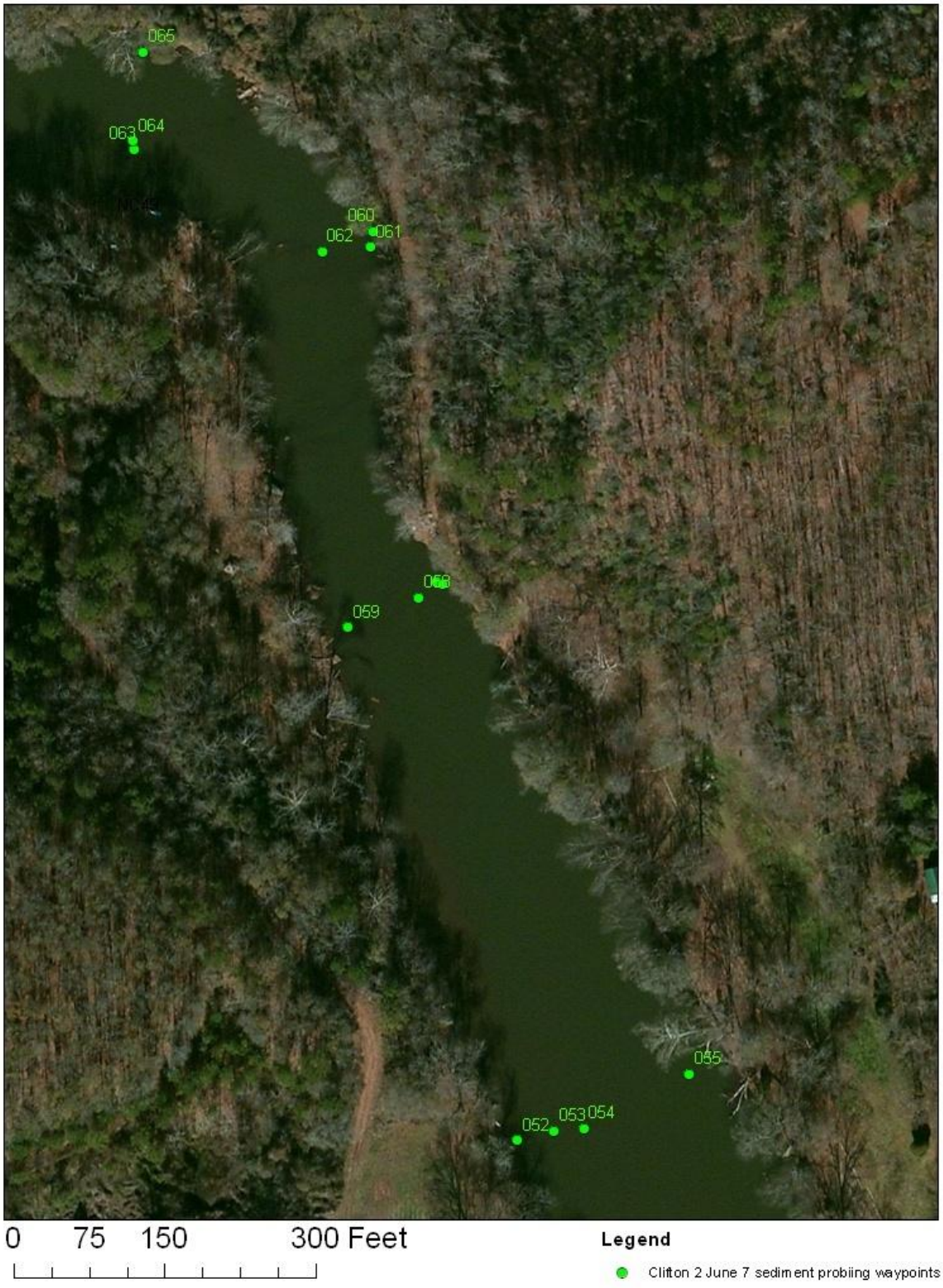

Figure 12c. Clifton 2 Mill Dam impounded area sediment characterization sites, June 7, 2012

Table 5. Clifton 2 Mill Dam bathymetry and bed material characterization data, June 7, 2012.

Waypoint	Latitude	Longitude	Water depth (ft)	Sediment depth to refusal (ft)	Qualitative sediment description	Photo reference
22	34.979281	-81.815768	4.25	4.75	Silty sand	
23	34.979231	-81.815815	4.75	5.25	Silty sand	
24	34.979233	-81.815675	6.5	6.75	Sand	
25	34.979284	-81.815528	7.25	7.5	Sand, gravel	
26	34.979354	-81.815331	6.75	7.0	Coarse sand, gravel	
27	34.979378	-81.815162	6.25	7.5	Silty sand	
28	34.979409	-81.815034	5.0	5.75	Coarse sand	
29	34.979419	-81.815022	3.75	4.25	Sandy silt	
30	34.979305	-81.814986	3.5	5.0	Silt	
31	34.979272	-81.814970	5.0	6.0	Silt	
32	34.979204	-81.814961	7.5	9.0	Silty sand	202, 203
33	34.979642	-81.815048	6.75	7.5	Coarse sand	
34	34.979627	-81.815090	8.5	8.5	Rock	
35	34.979589	-81.815212	8.5	9.5	Coarse sand	201, 200
36	34.979581	-81.815403	6.75	7.25	Silty sand	
37	34.979553	-81.815565	3.25	3.5	Sand	
38	34.979515	-81.815629	6.75	8.0	Coarse sand	
39	34.979881	-81.815676	3.0	4.75	Silty sand	199, 198
40	34.979952	-81.815406	7.0	8.0	Coarse sand	
41	34.979935	-81.815196	9.0	9.25	Silty sand, gravel	
42	34.979930	-81.815073	4.5	6.0	Silty sand	192, 193
43	34.979460	-81.815078	6.25	9.0	Silty sand	
44	34.980555	-81.815814	3.0	3.5	Sand	
45	34.980642	-81.815579	3.0	3.75	Coarse sand	
46	34.980673	-81.815436	4.75	5.25	Coarse sand	
47	34.980798	-81.815110	6.0	7.0	Silty sand	
48	34.981509	-81.815512	2.0	2.0	Rock	
49	34.981449	-81.815719	3.0	3.75	Coarse sand	186. 187
50	34.981403	-81.815887	3.5	3.5	Rock	
51	34.981294	-81.816056	2.5	3.25	Silty sand	
52	34.982491	-81.816761	3.0	3.75	Silty sand	
53	34.982515	-81.816636	4.0	6.0	Medium sand	185. 184
54	34.982522	-81.816535	4.75	5.75	Coarse sand	
55	34.982686	-81.816195	7.25	7.25	Rock	
56	34.984006	-81.817076	No data	No data	No data	
57	34.983999	-81.817061	2.25	2.25	Rock	
58	34.983955	-81.817133	2.0	2.0	Rock	
59	34.983868	-81.817372	3.0	3.0	Rock	
60	34.984955	-81.817321	3.0	3.0	Rock	
61	34.984907	-81.817325	3.5	3.5	Rock	
62	34.984890	-81.817488	5.0	5.5	Coarse sand	
63	34.985158	-81.818121	3.75	4.0	Coarse sand	
64	34.985184	-81.818126	6.75	7.25	Coarse sand	
65	34.985420	-81.818096	4.5	4.5	Rock	
66	34.979152	-81.815842	5.0	6.0	Silt, muck	
67	34.979090	-81.815864	5.0	7.0	Sand, silt, leaves	

Table 6. Clifton 2 Mill impoundment sediment particle sizes from samples collected June 7, 2012 (see Figures 12a and 12b for sample locations).

Sample Location	Lab Description	% Larger than sand	% Sand	% Silt	% Clay
WP-32	Brown Silty Fine Sand	2	69	25	4
WP-35	Brown Silty Fine to Coarse Sand	18	75	6	1
WP-39	Brown Silty Fine to Coarse Sand	0	87	11	2
WP-42	Brown Silty Medium to Fine Sand	1	64	30	5
WP-43	Brown Silty Fine to Coarse Sand	16	74	8	2
WP-49	Brown Fine to Coarse Sand	40	56	3	1
WP-53	Brown Fine to Coarse Sand	1	94	4	1

The sediments from the left bank (e.g., sites 32 and 42) had the highest silt content, and it is reasonable to expect they would contain the highest pollutant concentrations of sediments in the impoundment. Further, these sediments are expected to move downstream upon dam removal because of their close proximity to the dam. The SC DHEC's samples CMT-001 and CMT-002 were collected from this depositional area on the left side of the channel; as described on pages 21 to 25, pollutant concentrations in those two samples were less than conservative ecological effects screening values and therefore considered by USFWS as of no toxicological significance. Between these fringe areas on each bank (in the center of the impoundment), the sediments are mostly coarse sand and therefore of even lesser concern from a chemical pollutant standpoint.

Reports and Other Data

We pulled SC DHEC water quality data for Pacolet River from internet searches, and we made additional water and sediment data inquiries of U.S. Geological Survey, SC DHEC, Clemson University (Environmental Toxicology Program), and Furman University (Department of Earth and Environmental Science). The most relevant data from a sediment quality perspective are those from SC DHEC's 2012 sampling and analysis of the Pacolet River. The SC DHEC is analyzing those data and plans public meetings to present their results. We limited our interpretations to the stations closest to the Clifton 2 Mill, and those results were described above at pages 21-25.

Water quality and the health of the biotic community were assessed at several stations along the Pacolet River. Three bioassessment stations near Auriga Polymers, Inc. (the only pollutant source of concern identified in this tier 1 evaluation) were sampled for benthic macroinvertebrates (with the number and type of benthic animals used to assess river health) in 2011. Sites upstream, at the facility, and downstream of I-85 were rated as Good/Fair, but sediment contamination at Cherokee Creek's confluence with the Pacolet River was suggested for more assessment (Glover 2011).

Monitoring of Pacolet River water quality by SC DHEC indicates the only water quality impairments near the Clifton 2 Mill Dam impoundment are related to fecal coliform bacteria; other pollutants have been detected at concentrations within the State's water quality standards (SC

DHEC 1998, 2001, 2007, Wachob et al. 2009). There are no Pacolet River sediment quality data in these reports.

Flow information for the Pacolet River at Cowpens indicates record flows (22,900 cubic feet per second) on August 28, 1995. Although the monitoring station for the Pacolet River near Cowpens has only been in operation since 1993, the highest flow on record was from the same day that Tropical Storm Jerry affected the area (USGS 2011). Records show that flows during this event often exceeded the 100-year flow magnitude. This was likely a significant sediment moving event transporting materials in the bed sediments of the river; the Clifton 2 Mill Dam's 8 to 10-feet height would not be much of an impediment to movement of fine sediments in these flows. Record flows for the North Pacolet River (which has a longer period of record) were recorded following an unnamed hurricane in August 11-14, 1940.

Reviews

People familiar with the Clifton 2 Mill Dam's current status or history were interviewed to ascertain any information that would be useful in examining pollution sources to the area as well as the extent to which the dam is expected to retain sediments through time. Mr. David Strickland (of Spencer Hines Properties, pers. comm., May 4, 2012) knew of no pollution sources of concern in the watershed upstream of the mill. He indicated that the mill itself was the subject of a 1995 environmental audit (Law Engineering, Inc. 1995) which noted no concerns and which was subsequently retrieved by Mr. Eric Davis and reviewed as part of this evaluation. Mr. George Fields (of Palmetto Conservation Foundation, pers. comm., May 8, 2012) knows the area's history and relayed that the Clifton 2 Mill was only used for yarn spinning, without textile dyeing. He knew of no sediment quality data for the mill but provided a report on sediment quality for the dam at Glendale for reference. Other than the former Hoechst Celanese plant, no other pollution sources of concern within the watershed were noted. Don Bramblett (a local property owner, pers. comm., May 4, 2012) provided information on the extent of impoundment during the period when the gates were removed from the Clifton 2 Mill Dam. When the gates were out, the water was only about two feet deep in areas that were not exposed river bottom. Most of the area had the river bottom exposed and it was reported to be mostly coarse sand without muck and silt deposits. The only watershed pollution source of concern identified by Mr. Bramblett was the Hoechst Celanese plant. Ms. Stephanie Murdock (SC DHEC Solid Waste, pers. comm., May 23, 2012) was asked about solid waste facilities in the area, and only yard waste and inert construction and demolition debris facilities were identified.

Peer review comments

A draft report was circulated for review in August 2012. Thomas Rainwater (USFWS, Charleston Field Office), Lynnette Batt (American Rivers), and Cindy Carter (SC DHEC) provided feedback on the draft; their comments were largely editorial and have been addressed in this revised version.

Summary and Recommendations

For dam site development or restoration planning (including potential dam removal), USFWS believes no additional sediment characterization is needed to support an inference that movement of

the impoundment sediments downstream would be of no toxicological concern. Steps leading to this conclusion included searches of State and federal pollutant source databases to identify hazardous waste sites, surface water discharges, landfills and other potential pollutant sources in the assessment area of the Clifton 2 Mill Dam (which we defined as one mile on each side of the Pacolet River, from the dam upstream to Blalock Reservoir). We then reviewed State files for these facilities, and that review indicated than only the Auriga Polymers (formerly Hoechst Celanese) plant in Spartanburg warranted additional evaluation for potential sediment quality impairment in the vicinity of Clifton 2 Mill Dam.

Our evaluation of data for Auriga Polymers indicated it has known releases of volatile organic and semivolatile organic chemicals to the river, and contaminants of concern in groundwater at that site include DowTherm A (a commercial heat transfer fluid comprised of diphenyl oxide and 1,1-biphenyl), and various solvents, including 1,4-dioxane and chloroform. Fortuitously, the SC DHEC provided results of February 2012 sediment sampling of the Pacolet River including the entire assessment area (as well as upstream and downstream). There were three sediment samples within the impounded reach of the Clifton 2 Mill Dam among 34 samples from the Pacolet River drainage. Elemental contaminants, organochlorine pesticides, PCBs, PAHs, and volatile organic compounds in these sediments were typically either below detection limits or less than toxicological screening values and therefore considered by USFWS as not of toxicological significance. Concentrations were similar or higher downstream of the dam.

Sediment probing at 44 locations within the impoundment, and quantitative particle size determination of seven samples, indicates the bed material upstream of the Clifton 2 Mill Dam is dominated by fine to coarse sand with little potential to bind pollutants and therefore of little concern from a chemical pollutant standpoint. There are two areas of silt accumulation between the dam and Clifton-Glendale Road (SR 59), 10- to 25-feet from each bank and 1-2.5 feet deep. Aerial images from a 2007 dewatering event indicate that silt deposits are relatively recent. The left bank silt deposits were in the area sampled by SC DHEC, and our review of their data indicate contaminant levels were below concentrations of concern.

Three administrative issues should be considered and further addressed as part of site development or restoration planning. First, development or restoration interests need to follow-up with SC DHEC Federal and State Site Assessment Section's "Pre-CERCLIS Site Assessment" at the Clifton 2 Mill to ascertain their final action toward the Clifton 2 Mill. Based on their initial review of the data, the SC DHEC State and Federal Site Assessment Section anticipates recommending no further action on the Clifton 2 Mill at the federal and state levels, and those determinations and concurrences are expected by late September 2012. Second, the SC DHEC recommended consideration of some additional mill dam tailrace sediment samples for PAH analyses which may facilitate interaction with the SC DHEC Brownfields program which is an option for this site. Third, while our review was limited to sediment contaminant issues, our file review documented concerns with a 2008 proposal to mine sand adjacent to the mill. The SC DOT Hydraulic Design Support Section thought removing sand from the area between the dam and Clifton-Glendale Road would result in weakening the structural integrity of the bridge there. Because dam removal could be anticipated to change the dynamics of sand transport in the area, this concern should be pursued in advance of site development or restoration planning if dam removal is contemplated.

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Appendix A

Table 1. SC Compliance and Enforcement sites in the vicinity of named tributaries to the Pacolet River Clifton 2 Dam assessment area

cmp_enf_sitesnrTrib

CMP_ENF_ID	FILE_NAME	EPA_ID_NO	ADDRESS	CITY_NAME
106	A-CHEM CORPORATION	SCD030088918	HWY 29 SOUTH	COWPENS
222	YANCY CO INC	SCR000760694	1871 KING ST EXT	CHARLESTON
233	RR DONNELLEY & SONS COMPANY	SCD000613224	JONES ROAD AT ROUTE 57	SPARTANBURG
492	CLARKSON BROTHERS DEACTIVATED	SCD046504478	HWY 110 & I-85	COWPENS
540	RHONE-POULENC -SPARTANBURG PLANT	SCD055212922	399 SIMS CHAPEL ROAD	SPARTANBURG
553	ARTEVA SPECIALTIES	SCD056811367	I85 @ RD 57	SPARTANBURG
717	SAXONIA-FRANKE OF AMERICA	SCD093877090	DAVIS CHAPEL ROAD	SPARTANBURG
1110	FLINT INK CORPORATION	SCD982085615	JONES ROAD AT ROUTE 57 NE	SPARTANBURG
1609	AIR LIQUIDE AMERICA CORP	SCD077991818	125 BROOKS BLVD	SPARTANBURG
2116	HERTZ PENSKE TRUCK LEASING INC	SCD982085490	10 HUDSON DRIVE	SPARTANBURG
2151	TNS MILLS INC - SPARTANBURG DIVISION	SCD982093742	400 TNS RD	SPARTANBURG
2177	A & E AUTO ELECTRIC	SCD982097867	1235 OLD PACOLET HWY	SPARTANBURG
2800	CONNOR BODY SHOP	SCD987577095	2616 CANNONS CAMPGROUND R	SPARTANBURG
2863	PUTMAN BODY SHOP	SCD987578960	230 SLOAN GROVE RD	SPARTANBURG
2899	KIRSHBAUMS AUTO APPEARANCE	SCD987580263	199 FLOYD RD	SPARTANBURG
3062	COPAC INC	SCD987584240	195 DAVIS CHAPEL ROAD	SPARTANBURG
3255	POLYDECK SCREEN CORP	SCD987594231	175 DAVIS CHAPEL RD	SPARTANBURG
3468	SOUTHERN FINEBLANKING	SCD987598356	5798 NORTH MAIN ST	COWPENS
3508	MCDANIEL BOATS INC	SCN000000050	111 OLD CONVERSE ROAD	SPARTANBURG
3511	MARY BLACK MEMORIAL HOSPITAL	SCN000000058	1700 SKYLYN DRIVE	SPARTANBURG
3619	A & E REMFG AXLES & STRUTS	SCR000000083	3087 E MAIN ST EXT	SPARTANBURG
4177	M G INDUSTRIES	SCD982125833	I85 AT RD 57 FRONTAGE RD	SPARTANBURG
4255	PENSKE TRUCK LEASING CO LP	SCD982156473	HWY 221 & I-85-10 HUDSON	SPARTANBURG
4289	BETRAS	SCD982166829	HWY 221 & 85	SPARTANBURG

CMP_ENF_ID	FILE_NAME	EPA_ID_NO	ADDRESS	CITY_NAME
	PLASTICS			
4501	EXXON CO USA #45590	SCD987579307	SC 221 & I-85	SPARTANBURG
4565	STOWE WOODWARD	SCD987582665	I 85 AND RD 57	SPARTANBURG
4892	STOWE-WOODWARD CO	SCN000000077	I-85 ROAD 57 FRONTAGE RD	SPARTANBURG
4962	PRINTPAK INDUSTRIES	SCN000000314	ROAD 57 AT I-85N	SPARTANBURG
5065	TUSCARORA YARNS INC.	SCT000001131	BOX 5299 - CLIFTON GLENDA	SPARTANBURG
5319	HTX INC. (FORMERLY HEALTHTEX)		FOSTER STREET	COWPENS

Table 2. SC Leaking Underground Storage Tanks in the vicinity of named tributaries to the Pacolet River Clifton 2 Dam assessment area

LUST_nrTrib

SITE_NUI	FACILITY_I	LOCAL_FAC_	LOCAL_FAC1	LOCAL_FA_3	LOCAL_FA_4
12845	SC0000093517	371 BATTLEGROUND RD	COWPENS	Spartanburg	HOT SPOT 2018
12273	SC0000064638	2204 CHESNEE HWY	SPARTANBURG	Spartanburg	PANTRY 3291 DBA DEPOT
08001	SC0000070278	537 BURNS RD	SPARTANBURG	Spartanburg	CONVERSE SCHOOL BUS SHOP
08423	SC0000073805	RT 1 PO BOX 68	SPARTANBURG	Spartanburg	TURNERS QUICK MKT
08493	SC0000069070	HWY 221	SPARTANBURG	Spartanburg	GILREATH SAVMOR
14880		275 BUD ARTHUR BRIDGE RD AT I85	COWPENS	Spartanburg	POOR PAULS FIREWORKS
08311	SC0000036214	I 85 & US 221 RT 10	SPARTANBURG	Spartanburg	CHESNEE RD 66
08389	SC0000064170	100 BATTLEGROUND RD	COWPENS	Spartanburg	LIL CRICKET 207
08597	SC0000233583	4640 CHESNEE HWY	MAYO	Spartanburg	MAYO SPOT
08484	SC0000073805	RT 1	COWPENS	Cherokee	TILLMAN JOHNSON
08422	SC0000073805	841 BATTLEGROUND RD	COWPENS	Spartanburg	BEHELERS GRO
08370	SC0000069070	5109 S MAIN ST	COWPENS	Spartanburg	COWPENS RETAIL BULK PLANT
08249	SC0000074092	400 TNS RD	SPARTANBURG	Spartanburg	TNS MILLS INC
08379	SC0000070962	101 SHA LN	SPARTANBURG	Spartanburg	57 C STORE
08601	SC0000069222	5326 S MAIN ST	COWPENS	Spartanburg	COWPENS EXXON
14883	SC0000064017	106 SHA LN	SPARTANBURG	Spartanburg	SPINX 460
08459	SC0000067285	236 BATTTLEGROUN D RD	COWPENS	Spartanburg	SC511
08353	SC0000064170	4884 CHESNEE HWY	MAYO	Spartanburg	LIL CRICKET 272
08275	SC0000064411	140 CHESNEE HWY (SC 221 & I 85)	SPARTANBURG	Spartanburg	WHITES 2 EXXON
08077	SC0000074290	2400 E MAIN ST	SPARTANBURG	Spartanburg	LAN YAIR COUNTRY CLUB

Appendix B – Grain size analyses chain of custody and analytical report

U.S.Department of the Interior

U.S.Fish and Wildlife Service
551-F Pylon Drive
Raleigh NC 27606

Chain-of-Custody Record

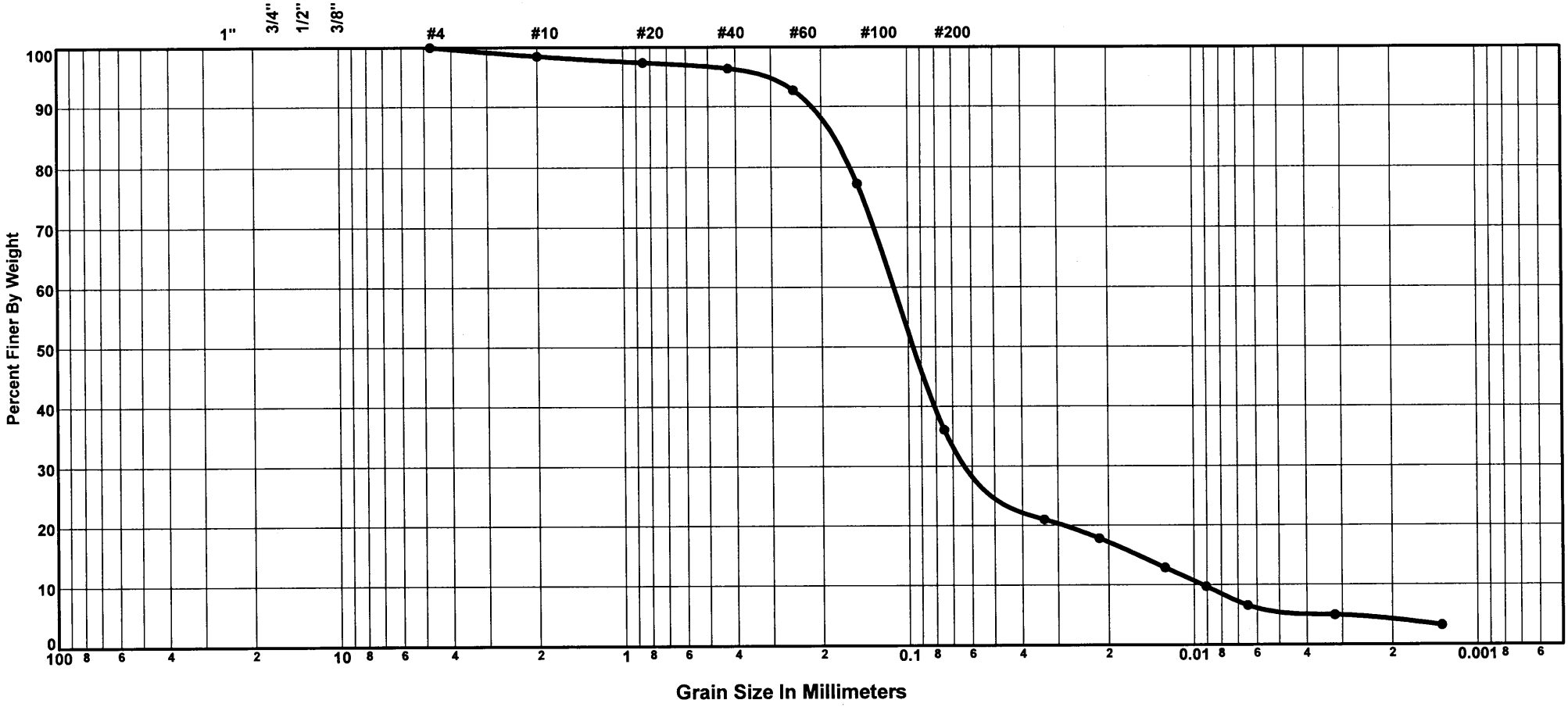
Study No. NA	Study Name: Tier 1 sediment evaluation of Clifton 2 dam	
Samplers: (Signatures) Tom Augspurger – USFWS 919-856-4520 x21 tom_augspurger@fws.gov		page 1 of 1

Sample Identification	Date	Time	Type *	Remarks and Observations
Waypoint 32	06-07-12		S	Pacolet River sediments-Clifton 2
Waypoint 35	06-07-12		S	Pacolet River sediments-Clifton 2
Waypoint 39	06-07-12		S	Pacolet River sediments-Clifton 2
Waypoint 42	06-07-12		S	Pacolet River sediments-Clifton 2
Waypoint 43	06-07-12		S	Pacolet River sediments-Clifton 2
Waypoint 49	06-07-12		S	Pacolet River sediments-Clifton 2
Waypoint 53	06-07-12		S	Pacolet River sediments-Clifton 2

Relinquished by: (Signature)	Date/Time 12:25p 6-15-12	Received by: (Signature) 6/15	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Relinquished by: (Signature)	Date/Time	Received for Laboratory by:(Signature)	Date/Time	Remarks	

* W=water, S=sediment, P=plant, F=fish, B=benthos, O=other, define in remarks

U.S. Standard Sieve Sizes



Grain Size In Millimeters

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

Boring No.	Elev./Depth	Nat. W.C.	L.L.	P.L.	P.I.	Soil Description or Classification
WP-32						Brown Silty Fine Sand

Project:

U.S. Fish and Wildlife Service
Raleigh, NC

Job No.: 1-12-0378-CA

Date: 6/26/12

Date Recieved: 6/15/2012

Dates Tested: 6/15-6/25/2012

GRAIN SIZE DISTRIBUTION

GeoTechnologies, Inc.
3200 Wellington Court, Suite 108
Raleigh, NC 27615

HYDROMETER WORK SHEET

JOB NAME: US Fish and Wildlife	JOB NO. 1-12-0378-CA

Boring		Sample	WP-32	Depth		Date	6/26/2012

Total Weight of Air Dried Sample	261.53
Weight Retained on #10 Sieve	3.99
Dry Wt. of Total Sample	252.27
Dry Wt. of Weight Passing #10 Sieve	3.85
Weight Passing #10 Sieve	257.54
Weight of Air Dried Hydrometer Sample	64.06
Dry Wt. of Hydrometer Sample	61.79

% Passing #10 Sieve	98.47

Spec.Grav.	2.65
Calc. a:	1

Hygroscopic Moisture	
Tare #	19
Tare Wt.	22.53
Wet Wt.	53.32
Dry Wt.	52.23
% Moisture	3.67

SAMPLE DESCRIPTION:

Brown Silty Fine Sand

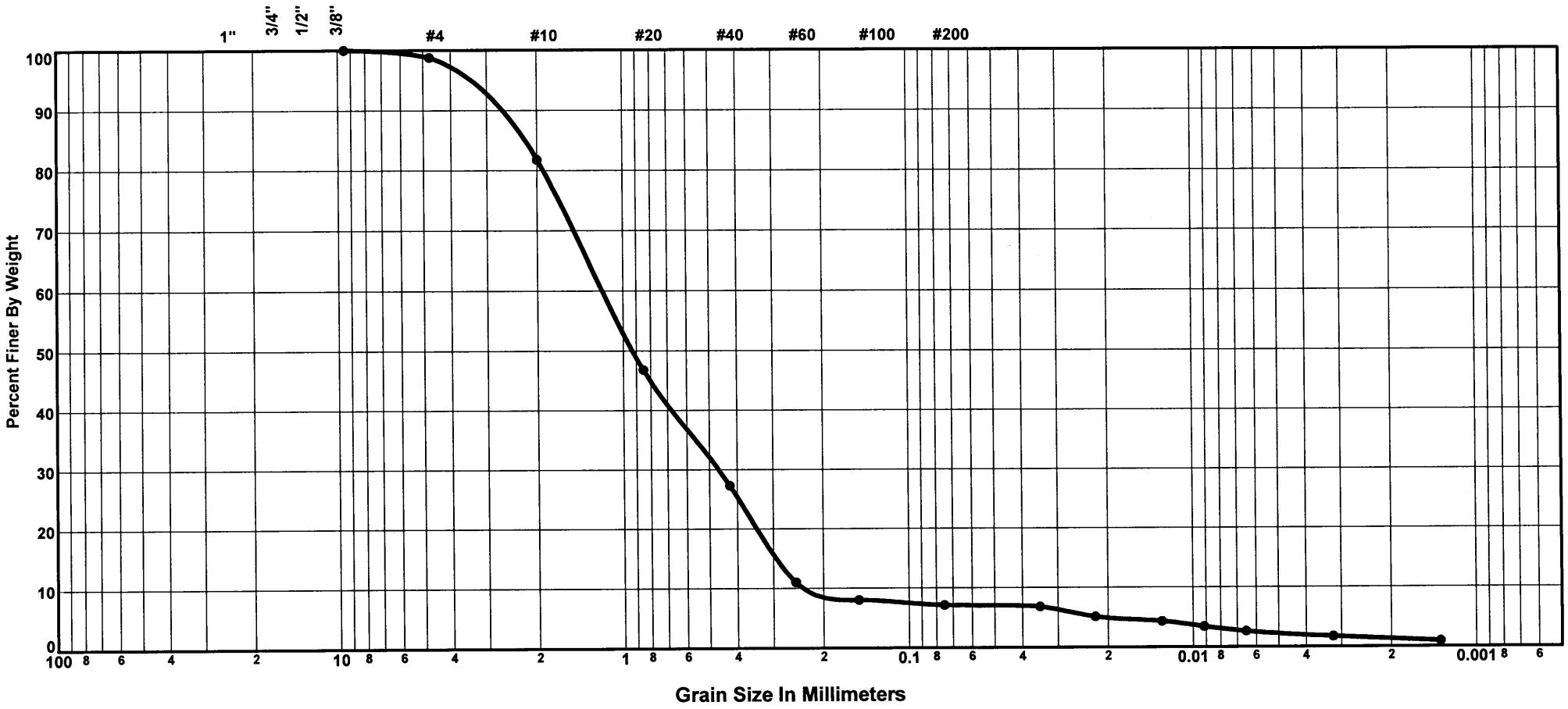
TIME (min.)	TEMP, C	HYD. READING	COMP. CORR.	CORRECT. READING	SOIL REMAINING %	K	L	DIAMETER (mm)
2	23.9	18.0	5.0	13.0	21.0	0.01303	13.3	0.03359
5	23.9	16.0	5.0	11.0	17.8	0.01303	13.7	0.02156
15	23.9	13.0	5.0	8.0	12.9	0.01303	14.2	0.01267
30	23.9	11.0	5.0	6.0	9.7	0.01303	14.5	0.00906
60	23.9	9.0	5.0	4.0	6.5	0.01303	14.8	0.00647
250	23.9	8.0	5.0	3.0	4.9	0.01303	15.0	0.00319
1440	23.9	7.0	5.0	2.0	3.2	0.01303	15.2	0.00134

Sieve	Wt. Retained	% Passing
3/4"	0.00	100.0
1/2"	0.00	100.0
3/8"	0.00	100.0
4	0.00	100.0
10	3.99	98.5
20	0.66	97.4
40	1.33	96.4
60	3.65	92.7
100	13.37	77.2
200	39.15	36.1

REMARKS:

Grain Size Wt.: 61.79

U.S. Standard Sieve Sizes



Grain Size In Millimeters

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

Boring No.	Elev./Depth	Nat. W.C.	L.L.	P.L.	P.I.	Soil Description or Classification
WP-35						Brown Silty Fine to Coarse Sand

Project:

U.S. Fish and Wildlife Service
Raleigh, NC

Job No.: 1-12-0378-CA

Date: 6/26/12

Date Recieved: 6/15/2012

Dates Tested: 6/15-6/25/2012

GRAIN SIZE DISTRIBUTION

GeoTechnologies, Inc.
3200 Wellington Court, Suite 108
Raleigh, NC 27615

HYDROMETER WORK SHEET

JOB NAME: US Fish and Wildlife	JOB NO. 1-12-0378-CA

Boring		Sample	WP-35	Depth		Date	6/26/2012

Total Weight of Air Dried Sample	353.65
Weight Retained on #10 Sieve	64.43
Dry Wt. of Total Sample	351.70
Dry Wt. of Weight Passing #10 Sieve	64.07
Weight Passing #10 Sieve	289.22
Weight of Air Dried Hydrometer Sample	118.05
Dry Wt. of Hydrometer Sample	117.40

Hygroscopic Moisture	
Tare #	CAT
Tare Wt.	21.43
Wet Wt.	50.4
Dry Wt.	50.24
% Moisture	0.56

% Passing #10 Sieve	81.78

SAMPLE DESCRIPTION:

Brown Silty Fine to Coarse Sand

Spec.Grav.	2.65
Calc. a:	1

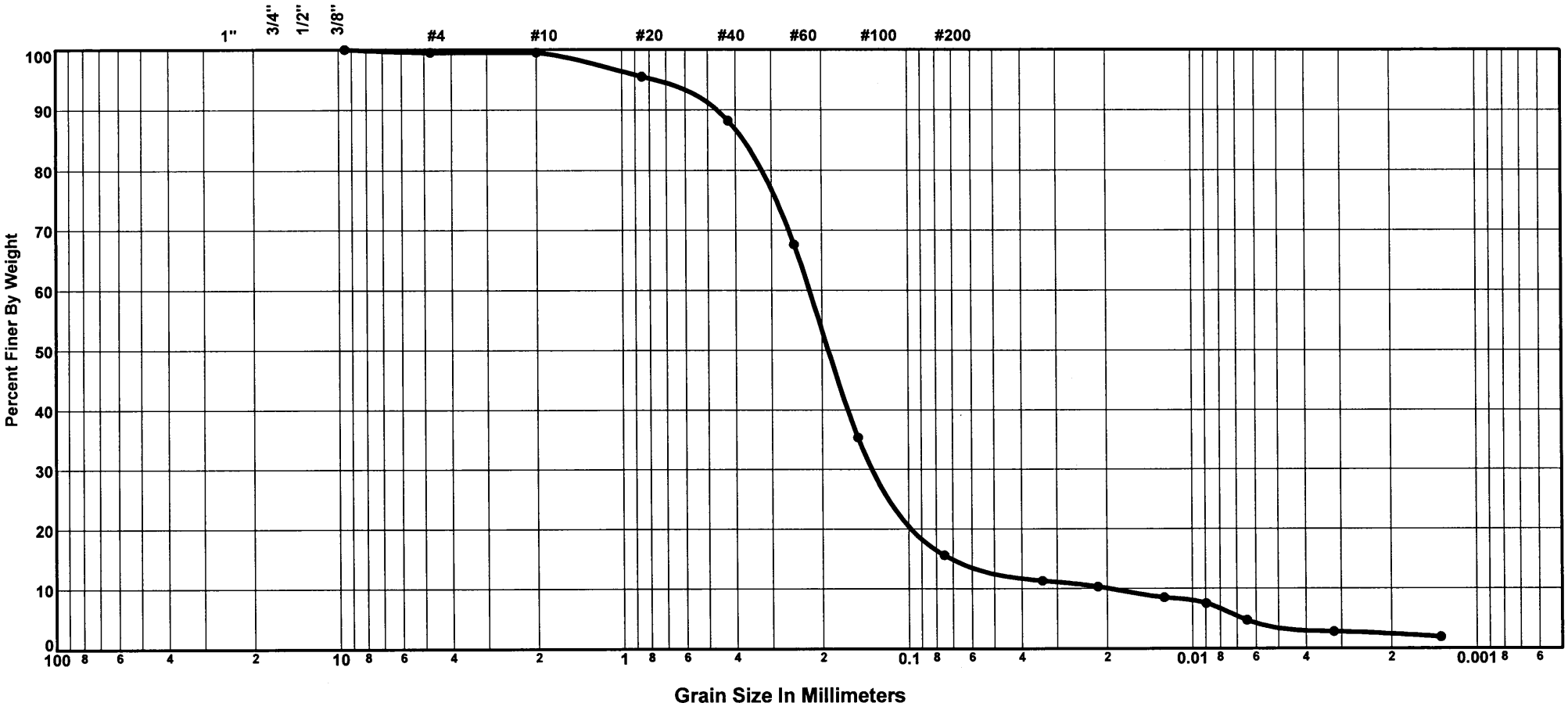
TIME (min.)	TEMP, C	HYD. READING	COMP. CORR.	CORRECT. READING	SOIL REMAINING %	K	L	DIAMETER (mm)
2	23.9	13.0	5.0	8.0	6.8	0.01303	14.2	0.03471
5	23.9	11.0	5.0	6.0	5.1	0.01303	14.5	0.02218
15	23.9	10.0	5.0	5.0	4.3	0.01303	14.7	0.01290
30	23.9	9.0	5.0	4.0	3.4	0.01303	14.8	0.00915
60	23.9	8.0	5.0	3.0	2.6	0.01303	15.0	0.00651
250	23.9	7.0	5.0	2.0	1.7	0.01303	15.2	0.00321
1440	23.9	6.0	5.0	1.0	0.9	0.01303	15.3	0.00134

Sieve	Wt. Retained	% Passing
3/4"	0.00	100.0
1/2"	0.00	100.0
3/8"	0.00	100.0
4	4.31	98.8
10	64.43	81.8
20	50.24	46.8
40	78.28	27.3
60	101.66	11.0
100	105.89	8.0
200	107.22	7.1

REMARKS:

Grain Size Wt.: 117.40

U.S. Standard Sieve Sizes



Grain Size In Millimeters

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

Boring No.	Elev./Depth	Nat. W.C.	L.L.	P.L.	P.I.	Soil Description or Classification
WP-39						Brown Silty Fine to Coarse Sand

Project:

U.S. Fish and Wildlife Service
Raleigh, NC

Job No.: 1-12-0378-CA

Date: 6/26/12

Date Recieved: 6/15/2012

Dates Tested: 6/15-6/25/2012

GRAIN SIZE DISTRIBUTION

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3200 Wellington Court, Suite 108
Raleigh, NC 27615

HYDROMETER WORK SHEET

JOB NAME: US Fish and Wildlife	JOB NO. 1-12-0378-CA

Boring		Sample	WP-39	Depth		Date	6/26/2012

Total Weight of Air Dried Sample		337.91
Weight Retained on #10 Sieve		1.63
Dry Wt. of Total Sample		320.48
Dry Wt. of Weight Passing #10 Sieve		1.55
Weight Passing #10 Sieve		336.28
Weight of Air Dried Hydrometer Sample		112.07
Dry Wt. of Hydrometer Sample		106.29

Hygroscopic Moisture	
Tare #	4
Tare Wt.	22.35
Wet Wt.	65.58
Dry Wt.	63.35
% Moisture	5.44

% Passing #10 Sieve	99.52

SAMPLE DESCRIPTION:

Brown Silty Fine to Coarse Sand

Spec.Grav.	2.65
Calc. a:	1

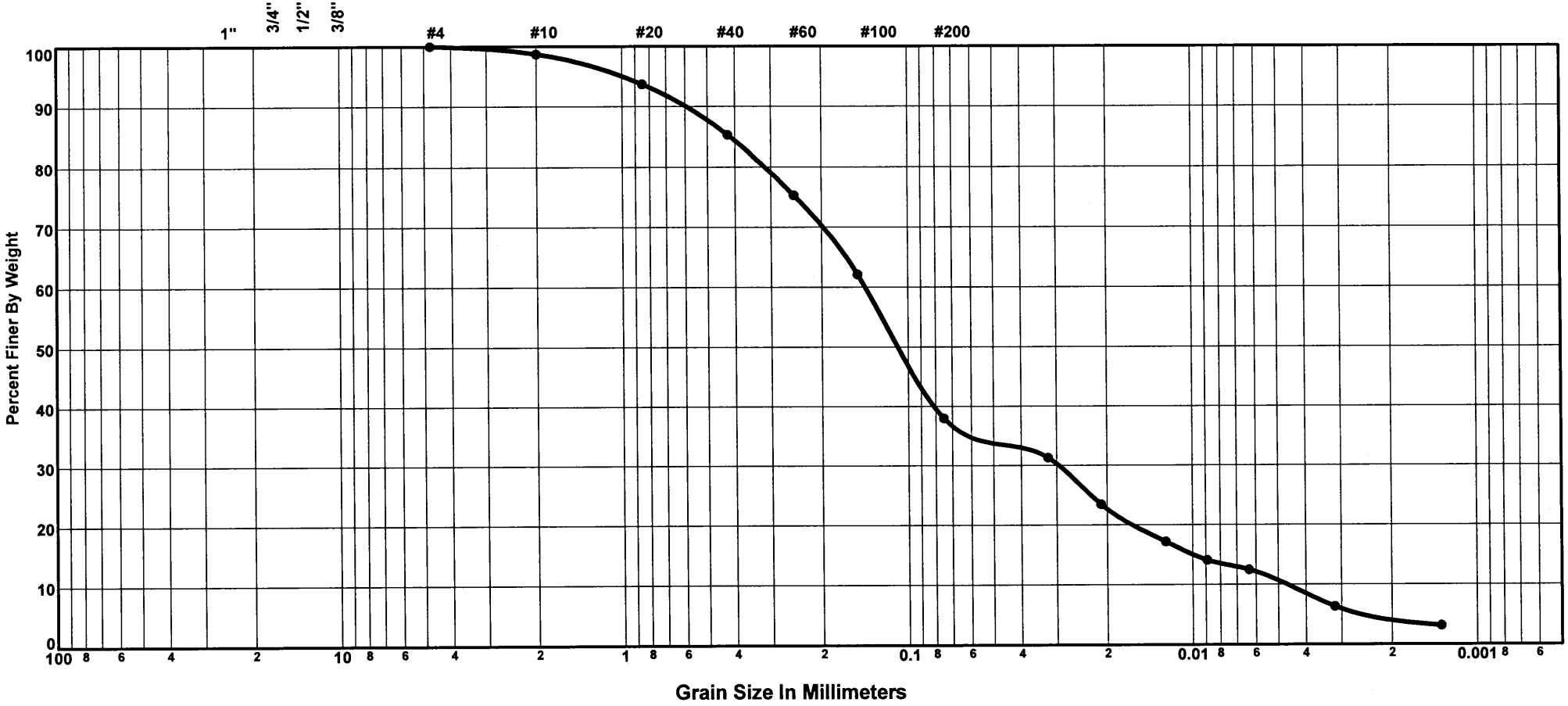
TIME (min.)	TEMP, C	HYD. READING	COMP. CORR.	CORRECT. READING	SOIL REMAINING %	K	L	DIAMETER (mm)
2	23.9	17.0	5.0	12.0	11.3	0.01303	13.5	0.03384
5	23.9	16.0	5.0	11.0	10.3	0.01303	13.7	0.02156
15	23.9	14.0	5.0	9.0	8.5	0.01303	14.0	0.01258
30	23.9	13.0	5.0	8.0	7.5	0.01303	14.2	0.00896
60	23.9	10.0	5.0	5.0	4.7	0.01303	14.7	0.00645
250	23.9	8.0	5.0	3.0	2.8	0.01303	15.0	0.00319
1440	23.9	7.0	5.0	2.0	1.9	0.01303	15.2	0.00134

Sieve	Wt. Retained	% Passing
3/4"	0.00	100.0
1/2"	0.00	100.0
3/8"	0.00	100.0
4	1.63	99.5
10	1.63	99.5
20	4.25	95.5
40	12.04	88.2
60	34.05	67.6
100	68.52	35.4
200	89.66	15.6

REMARKS:

Grain Size Wt.: 106.29

U.S. Standard Sieve Sizes



Grain Size In Millimeters

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

Boring No.	Elev./Depth	Nat. W.C.	L.L.	P.L.	P.I.	Soil Description or Classification
WP-42						Brown Silty Medium to Fine Sand

Project:

U.S. Fish and Wildlife Service
Raleigh, NC

Job No.: 1-12-0378-CA

Date: 6/26/12

Date Recieved: 6/15/2012

Dates Tested: 6/15-6/25/2012

GRAIN SIZE DISTRIBUTION

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Raleigh, NC 27615

HYDROMETER WORK SHEET

JOB NAME: US Fish and Wildlife	JOB NO. 1-12-0378-CA

Boring		Sample	WP-42	Depth		Date	6/26/2012

Total Weight of Air Dried Sample		144.78
Weight Retained on #10 Sieve		1.95
Dry Wt. of Total Sample		141.50
Dry Wt. of Weight Passing #10 Sieve		1.91
Weight Passing #10 Sieve		142.83
Weight of Air Dried Hydrometer Sample		65.40
Dry Wt. of Hydrometer Sample		63.92

Hygroscopic Moisture	
Tare #	33
Tare Wt.	22.15
Wet Wt.	49.51
Dry Wt.	48.89
% Moisture	2.32

% Passing #10 Sieve	98.65

SAMPLE DESCRIPTION:
Brown Silty Medium to Fine Sand

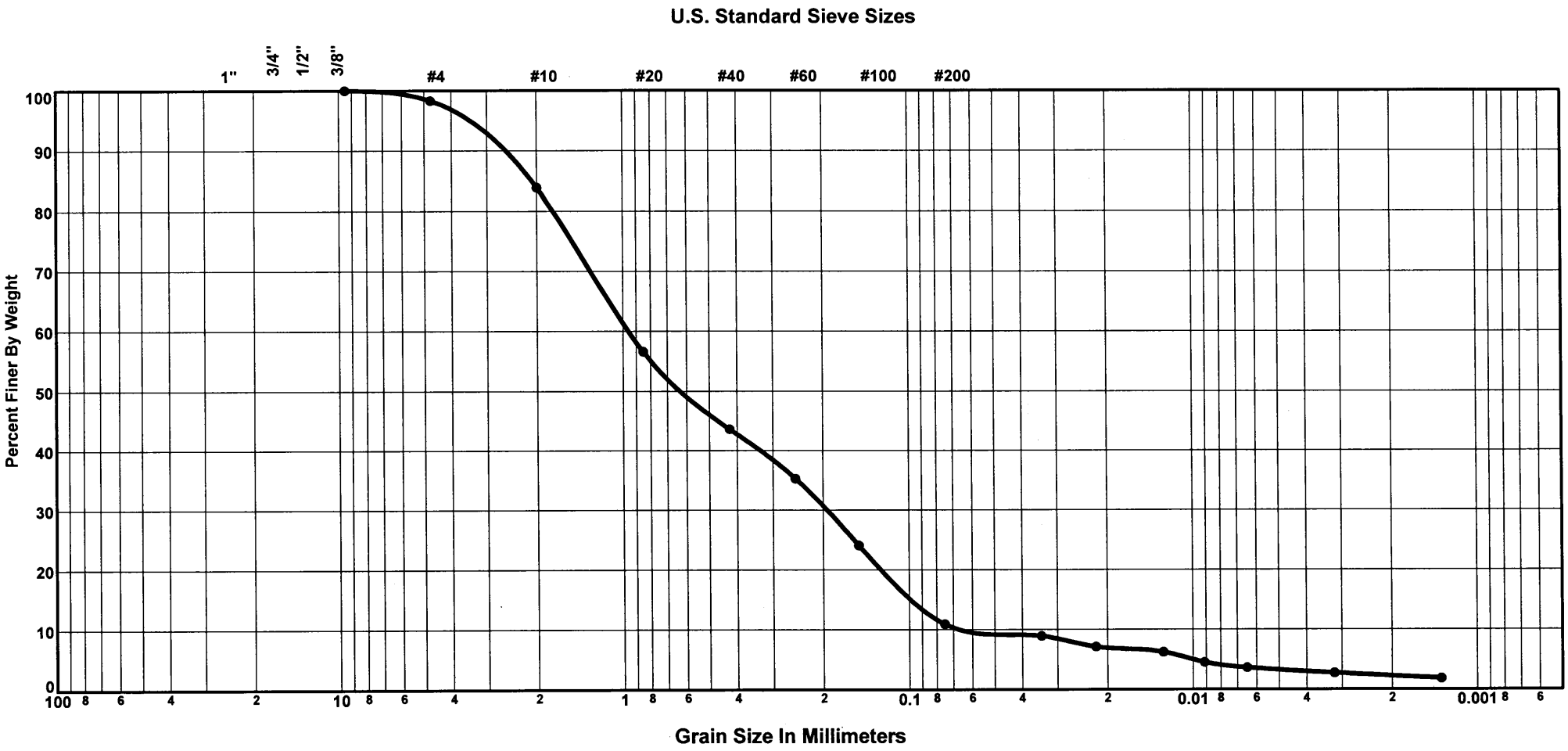
Spec.Grav.	2.65
Calc. a:	1

TIME (min.)	TEMP, C	HYD. READING	COMP. CORR.	CORRECT. READING	SOIL REMAINING %	K	L	DIAMETER (mm)
2	23.9	25.0	5.0	20.0	31.3	0.01303	12.2	0.03217
5	23.9	20.0	5.0	15.0	23.5	0.01303	13.0	0.02100
15	23.9	16.0	5.0	11.0	17.2	0.01303	13.7	0.01245
30	23.9	14.0	5.0	9.0	14.1	0.01303	14.0	0.00890
60	23.9	13.0	5.0	8.0	12.5	0.01303	14.2	0.00634
250	23.9	9.0	5.0	4.0	6.3	0.01303	14.8	0.00317
1440	23.9	7.0	5.0	2.0	3.1	0.01303	15.2	0.00134

Sieve	Wt. Retained	% Passing
3/4"	0.00	100.0
1/2"	0.00	100.0
3/8"	0.00	100.0
4	0.00	100.0
10	1.95	98.7
20	3.23	93.7
40	8.62	85.3
60	15.11	75.3
100	23.67	62.1
200	39.31	38.0

REMARKS:

Grain Size Wt.: 63.92



GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

Boring No.	Elev./Depth	Nat. W.C.	L.L.	P.L.	P.I.	Soil Description or Classification
WP-43						Brown Silty Fine to Coarse Sand

Project:

U.S. Fish and Wildlife Service
Raleigh, NC

Job No.: 1-12-0378-CA

Date: 6/26/12

Date Recieved: 6/15/2012

Dates Tested: 6/15-6/25/2012

GRAIN SIZE DISTRIBUTION

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Raleigh, NC 27615

HYDROMETER WORK SHEET

JOB NAME: US Fish and Wildlife	JOB NO. 1-12-0378-CA

Boring		Sample	WP-43	Depth		Date	6/26/2012

Total Weight of Air Dried Sample		285.27
Weight Retained on #10 Sieve		45.87
Dry Wt. of Total Sample		283.45
Dry Wt. of Weight Passing #10 Sieve		45.58
Weight Passing #10 Sieve		239.40
Weight of Air Dried Hydrometer Sample		112.93
Dry Wt. of Hydrometer Sample		112.21

Hygroscopic Moisture	
Tare #	29
Tare Wt.	22.25
Wet Wt.	51.97
Dry Wt.	51.78
% Moisture	0.64

% Passing #10 Sieve	83.92

SAMPLE DESCRIPTION:
Brown Silty Fine to Coarse Sand

Spec.Grav.	2.65
Calc. a:	1

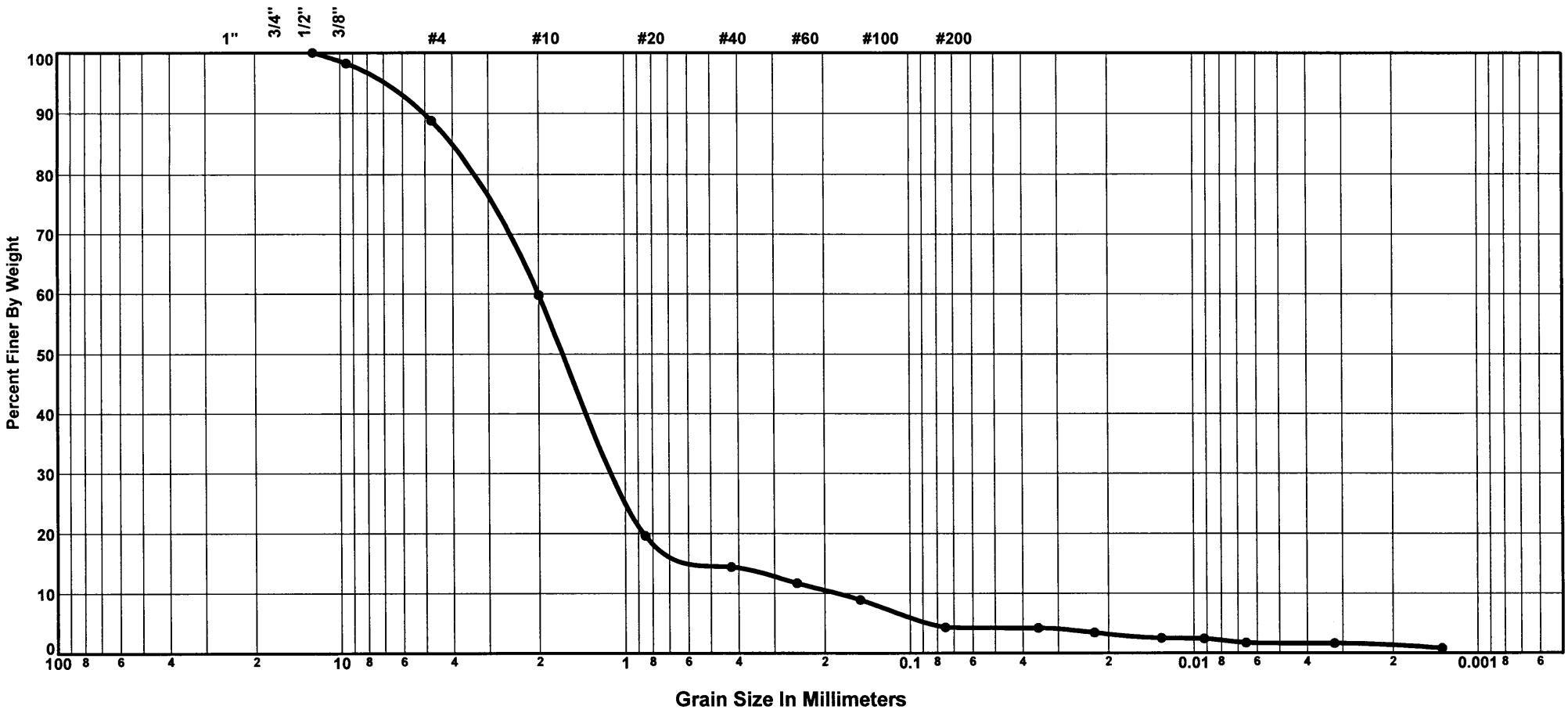
TIME (min.)	TEMP, C	HYD. READING	COMP. CORR.	CORRECT. READING	SOIL REMAINING %	K	L	DIAMETER (mm)
2	23.9	15.0	5.0	10.0	8.9	0.01303	13.8	0.03422
5	23.9	13.0	5.0	8.0	7.1	0.01303	14.2	0.02195
15	23.9	12.0	5.0	7.0	6.2	0.01303	14.3	0.01272
30	23.9	10.0	5.0	5.0	4.5	0.01303	14.7	0.00912
60	23.9	9.0	5.0	4.0	3.6	0.01303	14.8	0.00647
250	23.9	8.0	5.0	3.0	2.7	0.01303	15.0	0.00319
1440	23.9	7.0	5.0	2.0	1.8	0.01303	15.2	0.00134

Sieve	Wt. Retained	% Passing
3/4"	0.00	100.0
1/2"	0.00	100.0
3/8"	0.00	100.0
4	4.89	98.3
10	45.87	83.9
20	36.58	56.6
40	53.95	43.6
60	64.95	35.3
100	79.95	24.1
200	97.62	10.9

REMARKS:

Grain Size Wt.: 112.21

U.S. Standard Sieve Sizes



Grain Size In Millimeters

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

Boring No.	Elev./Depth	Nat. W.C.	L.L.	P.L.	P.I.	Soil Description or Classification
WP-49						Brown Fine to Coarse Sand

Project:

U.S. Fish and Wildlife Service
Raleigh, NC

Job No.: 1-12-0378-CA

Date: 6/26/12

Date Recieved: 6/15/2012

Dates Tested: 6/15-6/25/2012

GRAIN SIZE DISTRIBUTION

GeoTechnologies, Inc.

3200 Wellington Court, Suite 108
Raleigh, NC 27615

HYDROMETER WORK SHEET

JOB NAME: US Fish and Wildlife	JOB NO. 1-12-0378-CA

Boring		Sample	WP-49	Depth		Date	6/26/2012

Total Weight of Air Dried Sample		365.87
Weight Retained on #10 Sieve		146.94
Dry Wt. of Total Sample		364.67
Dry Wt. of Weight Passing #10 Sieve		146.46
Weight Passing #10 Sieve		218.93
Weight of Air Dried Hydrometer Sample		119.29
Dry Wt. of Hydrometer Sample		118.90

Hygroscopic Moisture	
Tare #	3
Tare Wt.	22.04
Wet Wt.	55.46
Dry Wt.	55.35
% Moisture	0.33

% Passing #10 Sieve	59.84

SAMPLE DESCRIPTION:
Brown Fine to Coarse Sand

Spec.Grav.	2.65
Calc. a:	1

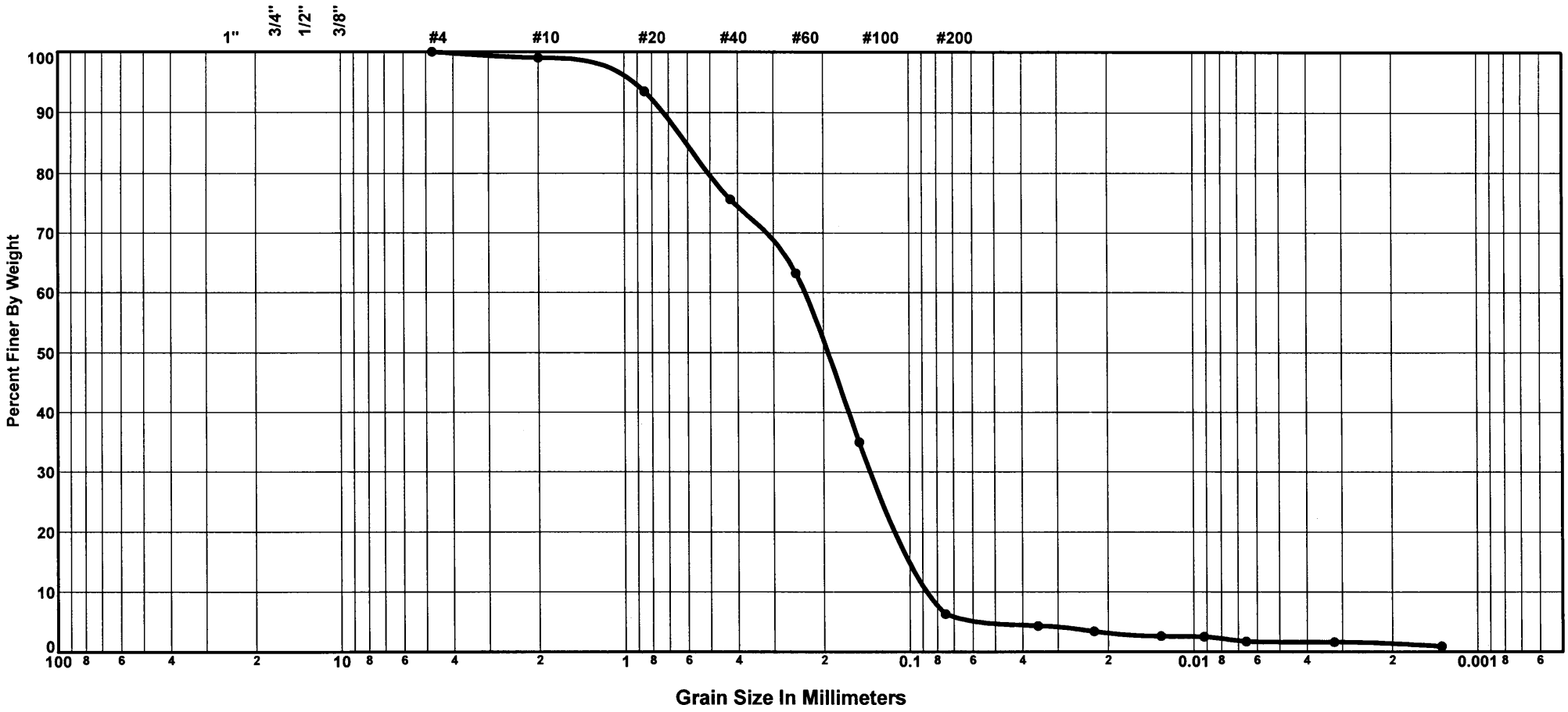
TIME (min.)	TEMP, C	HYD. READING	COMP. CORR.	CORRECT. READING	SOIL REMAINING %	K	L	DIAMETER (mm)
2	23.9	10.0	5.0	5.0	4.2	0.01303	14.7	0.03531
5	23.9	9.0	5.0	4.0	3.4	0.01303	14.8	0.02241
15	23.9	8.0	5.0	3.0	2.5	0.01303	15.0	0.01303
30	23.9	8.0	5.0	3.0	2.5	0.01303	15.0	0.00921
60	23.9	7.0	5.0	2.0	1.7	0.01303	15.2	0.00656
250	23.9	7.0	5.0	2.0	1.7	0.01303	15.2	0.00321
1440	23.9	6.0	5.0	1.0	0.8	0.01303	15.3	0.00134

Sieve	Wt. Retained	% Passing
3/4"	0.00	100.0
1/2"	0.00	100.0
3/8"	6.71	98.2
4	40.81	88.8
10	146.94	59.8
20	80.05	19.6
40	90.25	14.4
60	95.62	11.7
100	101.25	8.9
200	110.33	4.3

REMARKS:

Grain Size Wt.: 118.90

U.S. Standard Sieve Sizes



Grain Size In Millimeters

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

Boring No.	Elev./Depth	Nat. W.C.	L.L.	P.L.	P.I.	Soil Description or Classification
WP-53						Brown Fine to Coarse Sand

Project:

U.S. Fish and Wildlife Service
Raleigh, NC

Job No.: 1-12-0378-CA

Date: 6/26/12

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Dates Tested: 6/15-6/25/2012

GRAIN SIZE DISTRIBUTION

GeoTechnologies, Inc.
3200 Wellington Court, Suite 108
Raleigh, NC 27615

HYDROMETER WORK SHEET

JOB NAME: US Fish and Wildlife	JOB NO. 1-12-0378-CA

Boring		Sample	WP-53	Depth		Date	6/26/2012

Total Weight of Air Dried Sample	325.64
Weight Retained on #10 Sieve	3.37
Dry Wt. of Total Sample	323.85
Dry Wt. of Weight Passing #10 Sieve	3.35
Weight Passing #10 Sieve	322.27
Weight of Air Dried Hydrometer Sample	117.27
Dry Wt. of Hydrometer Sample	116.62

% Passing #10 Sieve	98.97

Spec.Grav.	2.65
Calc. a:	1

Hygroscopic Moisture	
Tare #	5
Tare Wt.	22.4
Wet Wt.	73.26
Dry Wt.	72.98
% Moisture	0.55

SAMPLE DESCRIPTION:

Brown Fine to Coarse Sand

TIME (min.)	TEMP, C	HYD. READING	COMP. CORR.	CORRECT. READING	SOIL REMAINING %	K	L	DIAMETER (mm)
2	23.9	10.0	5.0	5.0	4.3	0.01303	14.7	0.03531
5	23.9	9.0	5.0	4.0	3.4	0.01303	14.8	0.02241
15	23.9	8.0	5.0	3.0	2.6	0.01303	15.0	0.01303
30	23.9	8.0	5.0	3.0	2.6	0.01303	15.0	0.00921
60	23.9	7.0	5.0	2.0	1.7	0.01303	15.2	0.00656
250	23.9	7.0	5.0	2.0	1.7	0.01303	15.2	0.00321
1440	23.9	6.0	5.0	1.0	0.9	0.01303	15.3	0.00134

Sieve	Wt. Retained	% Passing
3/4"	0.00	100.0
1/2"	0.00	100.0
3/8"	0.00	100.0
4	0.00	100.0
10	3.37	99.0
20	6.43	93.5
40	27.52	75.6
60	42.20	63.2
100	75.39	35.0
200	109.17	6.3

REMARKS:

Grain Size Wt.: 116.62